1.4.1

VOLUME 1

Technical Report

Removal Site Assessment Report

Reynolds Metals Company
TROUTDALE FACILITY
OPERABLE UNIT 1

CH2M HILL

JANUARY 1995

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Abbreviations and Acronyms

bgs	below the ground surface
BPA	Bonneville Power Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CN^-	total cyanide
COE	U.S. Army Corps of Engineers
DEQ	Oregon Department of Environmental Quality
DOT	U.S. Department of Transportation
E&E	Ecology and Environment, Inc.
EM	electromagnetometer
EPA	U.S. Environmental Protection Agency
ER	electrical resistivity
ESP	electrostatic precipitator
Fl^-	soluble fluoride
GC/MS	gas chromatography/mass spectroscopy
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
NPDES	National Pollutant Discharge Elimination System
nT	nano-Tesla
OU1	Operable Unit 1
OWRD	Oregon Water Resources Department
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
ppm	parts per million
PVC	polyvinyl chloride
QASP	Quality Assurance Sampling Plan
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RMC	Reynolds Metals Company
RSA	removal site assessment

Abbreviations and Acronyms
(continued)

SIP	Site Inspection Prioritization
SVOC	semivolatile organic compound
TAT	Technical Assistance Team
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TPAH	total petroleum aromatic hydrocarbons
TPH	total petroleum hydrocarbons
TPH-D	TPH diesel fraction
TPH-G	TPH gasoline fraction
VOC	volatile organic compound

Executive Summary

Introduction

This report summarizes the results of a removal site assessment (RSA) for the Reynolds Metals Facility in Troutdale, Oregon. The removal site assessment was performed by Reynolds Metals Company (Reynolds Metals or RMC) and its contractor, CH2M HILL. The assessment was conducted to fulfill the requirements of the National Contingency Plan (40 CFR 300.410). Oversight of site assessment activities was performed by the U.S. Environmental Protection Agency (EPA) Region X Response Branch and its Technical Assistance Team (TAT). The TAT contractor for this assignment is Ecology and Environment, Inc. (E&E).

The purpose of this RSA is to determine the nature and extent of potentially hazardous substances in soil and groundwater at the facility, and the potential for migration of those substances. If the data obtained during the RSA indicate that a significant potential for release of hazardous substances exists that represents a threat to public health, public welfare, or the environment, removal actions may be taken to respond to the potential release.

This report presents the findings for the RSA of the Troutdale facility. The work is specific to Operable Unit 1 (OU1). OU1 primarily encompasses the interior portion of the property, which was associated with the production processes, and includes areas where waste materials were placed during previous plant operations. This site assessment focused on OU1 because it was thought to encompass the primary sources with the potential to affect groundwater and the environment.

Field work for the RSA began July 7, 1994, and was completed in late September 1994. The results of these field investigations are summarized in this report.

Background Information

Plant Description

Plant Location, Layout, and Operating Status

The RMC facility is a primary aluminum reduction plant where alumina (from bauxite) is reduced to aluminum. The plant is within Sections 14 and 22 through 24 of Township 1 North, Range 3 East, Willamette Meridian (45° 33' 07" north latitude, 122° 23' 22" west longitude). It is approximately 1.25 miles north of the city of Troutdale, Oregon.

The Columbia River forms the plant's northern border and the Sandy River forms its eastern border. A U.S. Army Corps of Engineers (COE) flood control dike surrounds the plant on the northern and eastern sides. Site areas north and east of the dike are located within the 100-year floodplain.

The area owned by Reynolds Metals in the vicinity of the plant has varied over the past 44 years. Currently, Reynolds Metals owns the 80.25-acre plant area and approximately 715 acres surrounding the plant. The plant area occupies the central part of the property. The site is generally flat, with some minor relief towards the south and the northeast corner of the area enclosed by the dike. The eastern part of the plant site is generally open fields and storage areas. North of the flood control dike the topography is generally flat, sloping gently toward the river, and transected by numerous small drainages.

The aluminum reduction plant has been shut down since November 1991 for economic reasons. It currently employs approximately 100 workers for maintenance, security, administration, and casting of ingots from molten aluminum transported to the plant from the RMC reduction plant in Longview, Washington.

Plant History and Production Processes

The plant was completed in 1941 for the U.S. government's wartime operations. Reynolds Metals first leased the plant from the government in June 1946 and purchased it in June 1949.

The RMC Troutdale plant uses what is known as the "prebake" method of producing aluminum. Carbon electrodes are produced at the facility's carbon plant from petroleum coke and coal tar pitch. These are set into carbon-lined reduction cells (known as pots). The carbon lining in the pots is made of anthracite coal, coal tar pitch, and graphite blocks. The carbon potlining acts as the cathode, while the carbon electrodes act as the anode.

Reduction takes place when electricity is passed from the anode to the cathode through an electrolyte solution of molten cryolite (Na_2AlF_6) and alumina. As the alumina is reduced, the aluminum is separated and settles to the bottom of the pot. At regular intervals, the molten aluminum is siphoned or tapped off and taken to the cast house, where it is made into sheet aluminum or foundry ingots of varying sizes. Other metals such as copper, beryllium, and chromium are added to produce various aluminum alloys.

Wastes Produced at the Plant

The plant has been on standby for the last 3 years and, as previously noted, waste production is minimal. During full production of aluminum, a number of wastes are produced at the plant. RMC identified 21 separate waste streams in response to a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) information needs letter. These 21 waste streams originate in the carbon plant, pot rooms, cast house, wastewater treatment plant, or at sites of miscellaneous plant operations. Wastes are currently disposed of at appropriate facilities. Historically, plant waste materials were placed at various locations throughout the plant site, typical of practices performed at industrial plants at the time.

Scope of RSA Activities

The scope of the OU1 removal site assessment included the bulleted items listed below:

- Perform reconnaissance activities to assist in development of the field work scope. These activities included review of previous agency investigations and historical aerial photographs of the facility, interviews of employees, and inspection of the entire plant site.

- Determine the nature and extent of material and substances in the following areas:

  - Unknown waste pile (the north landfill)
  - East potliner area
  - South landfill[1]
  - Scrap yard
  - Parking lot area
  - Former cryolite ponds
  - South wetlands area
  - Other miscellaneous areas

- Investigate alleged capacitor placement in the following areas:

  - South landfill
  - Unknown waste pile (the north landfill)
  - Various locations along the dike
  - Near the coke building

- Investigate the offsite migration of sediments and water that has occurred by evaluating surface water bodies, including:

  - Company Lake
  - Company Lake outfall ditch
  - Salmon Creek

- Investigate shallow groundwater quality and flow direction at locations potentially downgradient of perceived source areas and at the plant site perimeter.

- Investigate deep groundwater quality onsite and offsite.

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[1]For the purposes of this report, an area south of the plant site that was termed the "Potliner Disposal Area" in the SIP report is called the "south landfill." This change has been made because information available to date (including the results of this RSA) suggests that this area was not necessarily used for potliner disposal.

Summary of Results

Soil and Debris

Work Performed

The Phase 1 soil and debris investigation at the Reynolds Metals facility has consisted of the following components:

- Seventeen test pits were excavated in the north landfill area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis. One additional pit was excavated to investigate the alleged disposal of capacitors in the landfill.

- Sixteen test pits were excavated in the south landfill. The test pit soils were logged, and samples were collected and shipped to a laboratory for analysis.

- Eight test pits were excavated in the east potliner area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis. Two debris areas were also sampled and laboratory analyses were performed.

- Fifteen test pits were excavated in the scrap yard area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis.

- Four geoprobe holes were pushed in the east parking lot area. The geoprobe holes were logged, and samples were collected and shipped to a laboratory for analysis.

- Six hand auger holes were advanced in the cryolite ponds area. The hand auger holes were completed, and samples were collected and shipped to a laboratory for analysis.

- Six hand auger holes were advanced in the south wetlands area. The hand auger holes were completed, and samples were collected and shipped to a laboratory for analysis.

- Miscellaneous areas were identified during the site and aerial photograph reconnaissance as possible debris areas. These areas included the west field area, the sparse vegetation area at Fairview Farms, the outfall road, and the north dike. In all of these areas, samples were collected and shipped to a laboratory for analysis.

- A search was made for capacitors that were allegedly buried on the RMC site. A geophysical survey was performed, using a magnetic gradiometer, to search for the buried capacitors. On the basis of the results of the magnetometer survey, test pits were excavated in the north landfill and under the Bonneville Power Administration (BPA) power lines in an attempt to locate any buried capacitors.

- A geophysical (electrical resistivity [ER]) survey of the south landfill was performed. The purpose of the ER survey was to help map the depth and extent of waste material in the south landfill. On the basis of the survey, five test pits were excavated and sampled.

Analytical Results

In general, soil samples were analyzed for the following constituents:

- Soluble fluoride and total cyanide (Fl^- and CN^-, respectively)
- Total polychlorinated biphenyls (PCBs) (PCB aroclors were analyzed for 10 percent of all samples)
- Total polynuclear aromatic hydrocarbons (PAHs) (PAH species were analyzed for 10 percent of all samples)
- EPA priority pollutant metals (13 metals: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc)

Some areas had additional and/or different analyses performed on the basis of either the results of previous EPA investigations or what was detected in the field. These analyses included the following:

- Solvents
- Toxicity characteristic leaching procedure (TCLP) metals (north landfill–east area)
- EPA 7000 Series metals (23 metals)
- Chlorinated pesticides
- Total petroleum hydrocarbons (TPH), the TPH diesel fraction (TPH-D), and the TPH gasoline fraction (TPH-G)
- Total organic carbon (TOC)

No comparison against standards is made for soil or sediment analytical results. There are currently no generally accepted health or ecologically based standards, criteria, or guidelines for comparing the concentrations of substances in soil at the Troutdale plant. Substances detected (excluding metals) and maximum concentrations for each area are as follows:[2]

- **North Landfill.** PAHs, PCBs, TPH, cyanide, and fluoride were detected. The maximum concentrations detected in the east area were as follows: CN^-, 1.1 milligram per kilogram (mg/kg); PAHs, 2,350 mg/kg (as sum of detected compounds); PCBs, 31 mg/kg; and TPH, 120 mg/kg. Maximum concentrations of constituents encountered in the west area were as follows: CN^-, 1.6 mg/kg; Fl^-, 490 mg/kg; PAHs, >1,400 mg/kg; and PCBs, 28 mg/kg (discrete subsurface soil at 5 feet below the ground surface [bgs]).

- **South Landfill.** PAHs and PCBs, as well as cyanide and fluoride, were detected. The maximum concentrations detected were as follows: total PAHs, >10,000 mg/kg (one sample); PCBs (as sum of aroclors), 2.5 mg/kg; CN^-, 44 mg/kg; and Fl^-, >1,000 mg/kg.

- **East Potliner Area.** PAHs, PCBs, cyanide, and fluoride were detected. The maximum concentrations detected were as follows: total PAHs, 2 mg/kg; PCBs, 0.43 mg/kg (discrete surface soil); CN^-, 3.8 mg/kg; and Fl^-, >500 mg/kg.

- **Scrap Yard.** PAHs, PCBs, cyanide, and fluoride were detected. The maximum concentrations detected were as follows: PAHs >2,800 mg/kg (discrete surface soil); PCBs, 16 mg/kg (discrete surface soil); CN^-, 21 mg/kg; and Fl^-, 1,800 mg/kg.

- **Parking Lot.** No PAHs, PCBs, or CN^- were detected in samples. The samples were not tested for fluoride.

- **Cryolite Ponds Area.** PAHs, cyanide, and fluoride were detected. PCBs were not detected. The maximum concentrations detected were as follows: PAHs, 61 mg/kg; CN^-, 100 mg/kg (discrete surface soil); and Fl^-, 2,100 mg/kg.

- **South Wetlands Area.** PAHs and PCBs, as well as cyanide, fluoride, and chlorinated pesticides, were detected. The maximum concentrations detected were as follows: CN^-, 2.9 mg/kg; Fl^-, >500 mg/kg (three samples); PAHs, 19 mg/kg (discrete surface soil); PCBs (discrete surface soil), 45 mg/kg; DDD, 0.8 mg/kg; DDE, 0.05 mg/kg; and DDT, 0.28 mg/kg.

Data collected from the miscellaneous areas sampled are described in Section 2 of this report.

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[2]Unless otherwise indicated, data results are for composite sample analyses. Metal concentrations are summarized in the main body of this report.

Groundwater

Work Performed

The groundwater investigation at the Reynolds Metals site has consisted of the following components to date:

- A first phase of groundwater monitoring well installations (MW01 through MW08)
- Surveying and sampling of the first phase of monitoring wells and key surface water features to evaluate water level elevations and shallow groundwater quality
- A second phase of monitoring well installations (MW09 through MW12)
- Shallow groundwater sampling (all 12 monitoring wells, 1 BPA shallow monitoring well, 4 dewatering sumps, and 1 wellpoint near the bakehouse)
- Groundwater sampling at five deep Reynolds production wells
- Groundwater sampling at three offsite well locations (one shallow, two deep)
- Ongoing groundwater elevation monitoring

Groundwater samples were collected from the first phase monitoring wells (MW01 through MW08) on July 19, 1994. Groundwater samples were collected from the second phase monitoring wells (MW09 through MW12), selected first phase wells, and a shallow BPA monitoring well (BPAT-05), on August 15 and 16, 1994. Groundwater samples were collected from five of the deep Reynolds production wells on August 16, 1994. (The shallowest screened interval for these deep wells is approximately 148 feet bgs.) Water samples were collected from four of the bakehouse dewatering sumps and one of the bakehouse wellpoints on August 25, 1994. Two samples were collected from deep offsite wells (deeper than 150 feet), and one sample from a shallower (130-foot-deep) offsite well west and northwest of the RMC facility on August 25, 1994.

Water Level Elevations

Shallow groundwater in the project vicinity generally occurs in an unconfined, or water table, silt and sand aquifer within 10 to 20 feet of the ground surface. The groundwater elevation data indicate that, in general, shallow groundwater moves from the southeast to the northwest across the site. The exceptions to this generalized flow pattern occur at the following locations:

- Near the Columbia River, which flows from east to west across the northern site boundary. Shallow groundwater appears to be influenced by the Columbia River and flows south to north near the river's edge.

- Near the Sandy River, which flows from southeast to northwest along the eastern site boundary. Shallow groundwater appears to be influenced by the Sandy River and flows southwest to northeast near the river's edge.

- Near the scrap yard area. A depression in the water table surface appears to exist just east of the carbon plant. As a result of this condition, groundwater flow in the vicinity of the scrap yard appears to converge toward the scrap yard from all directions.

- Near the wastewater treatment plant where MW01 appears to define a mound, or high, in the water table surface. As a result of this condition, groundwater is likely to flow away from the mound in all directions.

- Near the bakehouse. An operational dewatering system is in place in and around the bakehouse. This dewatering causes a groundwater low, or depression, in the water table surface in the vicinity of the bakehouse. As a result of this condition, groundwater flow in the vicinity of the bakehouse appears to converge toward the bakehouse from all directions.

Analytical Results

The results of these sampling efforts can be summarized as follows:

- Shallow groundwater appears to have been affected locally by facility operations, though generally not at locations near the site perimeter. Fluoride concentrations (ranging from less than 0.5 milligram per liter [mg/L] to 570 mg/L) exceeded the EPA maximum contaminant level (MCL) for drinking water (4 mg/L) at six of the seven locations where fluoride was detected. At MW10 and MW11, antimony concentrations (0.0082 and 0.0072 mg/L, respectively) exceeded the EPA drinking water MCL of 0.006 mg/L. Concentrations of arsenic and nickel (0.83 and 0.22 mg/L) also exceeded EPA drinking water MCLs (0.05 and 0.002 mg/L) at MW11. It has not been determined that it is appropriate to apply drinking water criteria at this site, and the significance of exceeding EPA drinking water MCLs has not been evaluated.

- Constituent concentrations in water samples collected from dewatering sumps near the bakehouse also exceeded EPA drinking water MCLs. Fluoride concentrations (ranging from 1.4 to 140 mg/L) exceeded the EPA drinking water MCL (4 mg/L) at three of the five locations sampled. At three of the locations, individual PAHs also exceeded MCLs.

Because the sumps near the bakehouse are active dewatering sumps, and there is potential for materials to have been placed in those sumps, it is possible that the water samples described above do not actually reflect groundwater conditions in the vicinity of the bakehouse.

- Total cyanide was detected in deeper groundwater at one of the five production wells sampled: 0.24 mg/L at PW18. No free cyanide was detected in any of the five production well samples. Fluoride was detected (1.3 and 0.64 mg/L at PW08 and PW18) at concentrations below the EPA drinking water MCL of 4 mg/L.

- Groundwater samples collected from three offsite wells indicate that groundwater at these locations has not been affected by facility operations.

Work in Progress

Several aspects of the groundwater investigation at the Reynolds Metals facility are in progress and will be included in a later report. The portions of the groundwater investigation that are in progress are summarized below:

- Water level elevation monitoring at the site continues. Beginning in November 1994, manual measurements will be collected monthly, although several data loggers will remain in place to collect more frequent measurements at key locations. The water level data will be evaluated to assess the relationship between groundwater and surface water, shallow groundwater and deeper groundwater, and seasonal variation in groundwater movement. Deep water levels will be measured at RMC production wells to assess flow directions in the deeper zones. This information will be used to develop a conceptual hydrogeologic model for the project area, and will be included in a later report.

- The cause of the depression in the water table surface in the vicinity of the scrap yard is under investigation. One potential cause of the depression is the presence of one or more former production wells that have not been abandoned, which could potentially provide a conduit for the vertical migration of groundwater. The location and condition of any unabandoned wells in the vicinity of the scrap yard will be assessed, and plans for abandonment and monitoring will be developed.

- The cause of the groundwater mound in the vicinity of the wastewater treatment system is under investigation. A leaking water supply main north of the wastewater treatment system will be repaired and the effects of this repair will be evaluated. In addition, recent changes in the operation of the treatment system could have temporarily affected water levels in the area. Frequent water level measurements at MW01 will be used to evaluate any changes in water level elevation that might result from stabilization of clarifier operations and, later, repair of the leaking water supply system.

- The bakehouse sumps and wellpoints will be evaluated to assess all potential points of inflow and outflow. High-frequency water level monitoring at some sump locations may lead to a better understanding of the water level elevations in the bakehouse area. The results of this evaluation may lead to additional water and sediment sampling and removal of sediment from selected sumps. The wellpoint construction will be evaluated to assess the need for abandonment.

The work described above will be combined with an assessment of area geology, hydrogeology, review of existing literature and information, and development of hydrostratigraphic cross sections to develop a conceptual hydrogeologic model for the site and vicinity. This evaluation will be included in a later report.

Surface Water and Sediment

Work Performed

Surface water and sediment samples were collected from the following general locations in and around the RMC facility:

- Columbia River
- Company Lake and outfall ditch
- Salmon Creek
- East Lake

Analytical Results

Columbia River. No cyanide, fluoride, PCBs, or TPHs were detected in two Columbia River sediment samples collected upstream from the RMC facility. PAHs (as a sum of detected constituents) were found in one of the samples at 1.1 mg/kg total.

No cyanide, TPH, or PCBs were detected in two Columbia River sediment samples collected near the Company Lake outfall. One sample detected fluoride at 13 mg/kg. Detected PAH concentrations (0.19 and 0.10 mg/kg as a sum of detected constituents) are lower than the concentration noted in sediment upstream of the RMC facility. Metals concentrations in sediment at this location are similar to concentrations detected upstream of the RMC facility.

No cyanide, fluoride, PAHs, or PCBs were detected in Columbia River surface water upstream of the RMC facility or near the Company Lake outfall.

Company Lake and Outfall Ditch. In the five sediment samples collected from the bottom of Company Lake, total cyanide was detected in only one sample (10 mg/kg); fluoride ranged from 780 to 5,800 mg/kg; total PAHs (as a sum of detected constituents) ranged from 407 to 23,540 mg/kg; PCBs ranged from 2 to 3.5 mg/kg; and TPH ranged from 620 to 1,300 mg/kg. Metals concentrations were generally elevated relative to the sediments in the Columbia River.

No cyanide, PAHs, or PCBs were detected in Company Lake surface water. Detected fluoride concentrations ranged from 1.7 to 3 mg/L.

Salmon Creek. Four sediment samples were collected from the Salmon Creek drainage system: one where the drainage enters the southwestern portion of the RMC site, one just before the drainage exits the site at the eastern edge of Sundial Road, and two just west of Sundial Road.

Where the drainage enters the site, no cyanide, fluoride, or PCBs were detected. PAHs (as a sum of detected constituents) were measured at 0.7 mg/kg, TPH was detected at 290 mg/kg, and TPH-D was detected at 170 mg/kg.

No fluoride or PCBs were detected in the sediment sample collected from the Salmon Creek drainage as it exits the RMC site. The sample did contain total cyanide at 2.2 mg/kg, PAHs (as a sum of detected constituents) at 10.6 mg/kg, and TPH at 120 mg/kg.

No cyanide, fluoride, or PCBs were detected in the two sediment samples collected west of Sundial Road. Total PAHs (as a sum of detected constituents) were measured at 4.4 and 0.25 mg/kg, and TPH was detected in one sample at 24 mg/kg.

In general, metals concentrations in Salmon Creek sediments are slightly elevated relative to Columbia River sediments, although lower than Company Lake sediments.

Surface water samples collected where the Salmon Creek drainage enters the site and where it exits the site near Sundial Road showed no detectable concentrations of cyanide, fluoride, PAHs, or PCBs. Metals concentrations in Salmon Creek surface water are similar to concentrations observed in Columbia River water both upstream and downstream of the RMC facility.

East Lake. One sediment and one surface water sample were collected from East Lake, a small pond east of Company Lake. No cyanide, fluoride, PCBs, or TPH were detected in the East Lake sediment sample. Total PAHs (as a sum of detected constituents) were measured at 7.4 mg/kg. In general, metals concentrations in East Lake sediments are comparable to the concentrations observed in Salmon Creek drainage ditch sediments upgradient of the site, and lower than those observed in Columbia River sediments.

No cyanide, PAHs, or PCBs were detected in the East Lake surface water sample. Fluoride was detected at 0.7 mg/L. In general, metals concentrations in East Lake surface water were lower than at the other locations where surface water was sampled.

Section 1
Subject and Purpose of Investigation

Introduction

This report summarizes the results of a removal site assessment (RSA) for the Reynolds Metals Facility in Troutdale, Oregon (Figure 1-1). The RSA was performed by Reynolds Metals Company (Reynolds Metals or RMC) and its contractor, CH2M HILL. The assessment was conducted to fulfill the requirements of the National Contingency Plan (40 CFR 300.410).

Oversight of site assessment activities was performed by the U.S. Environmental Protection Agency (EPA) Region X Response Branch and their Technical Assistance Team (TAT). The TAT contractor for this assignment is Ecology and Environment (E&E).

Summary of Activities

Site Inspection Prioritization

In 1992 and 1993 EPA's contractor, PRC, conducted a site inspection prioritization (SIP) project of the RMC Troutdale plant. The work included a review of background information about the plant and a site visit to conduct sampling. The results of PRC's work are summarized in PRC's Site Inspection Prioritization Report (*Final Site Inspection Prioritization, Reynolds Metals Company, Troutdale, Oregon* ORD009412677, EPA Region 10). The information obtained from the SIP project was used by EPA to determine whether the Troutdale plant should be listed on the National Priorities List of Superfund sites.

Removal Site Assessment

From the SIP project it was determined by EPA Region X that an additional evaluation, the RSA, was required at the Troutdale facility. The purpose of the RSA is to determine the nature and extent of potentially hazardous substances in soil and groundwater at the facility, and the potential for migration of those substances. If, from the data obtained from the removal site assessment, there is considered to be potential for release of hazardous substances that represents a threat to public health or welfare or the environment, removal actions may be taken to respond to the release.

As originally planned by EPA, there were expected to be at least two operable units at the Troutdale facility. Operable Unit 1 (OU1) primarily encompasses the interior portion of the property, which was associated with the production processes, and includes areas where waste materials were placed during previous plant operations. Operable Unit 2 (OU2) generally encompasses perimeter areas, including the adjacent rivers, and areas contiguous to the interior property.

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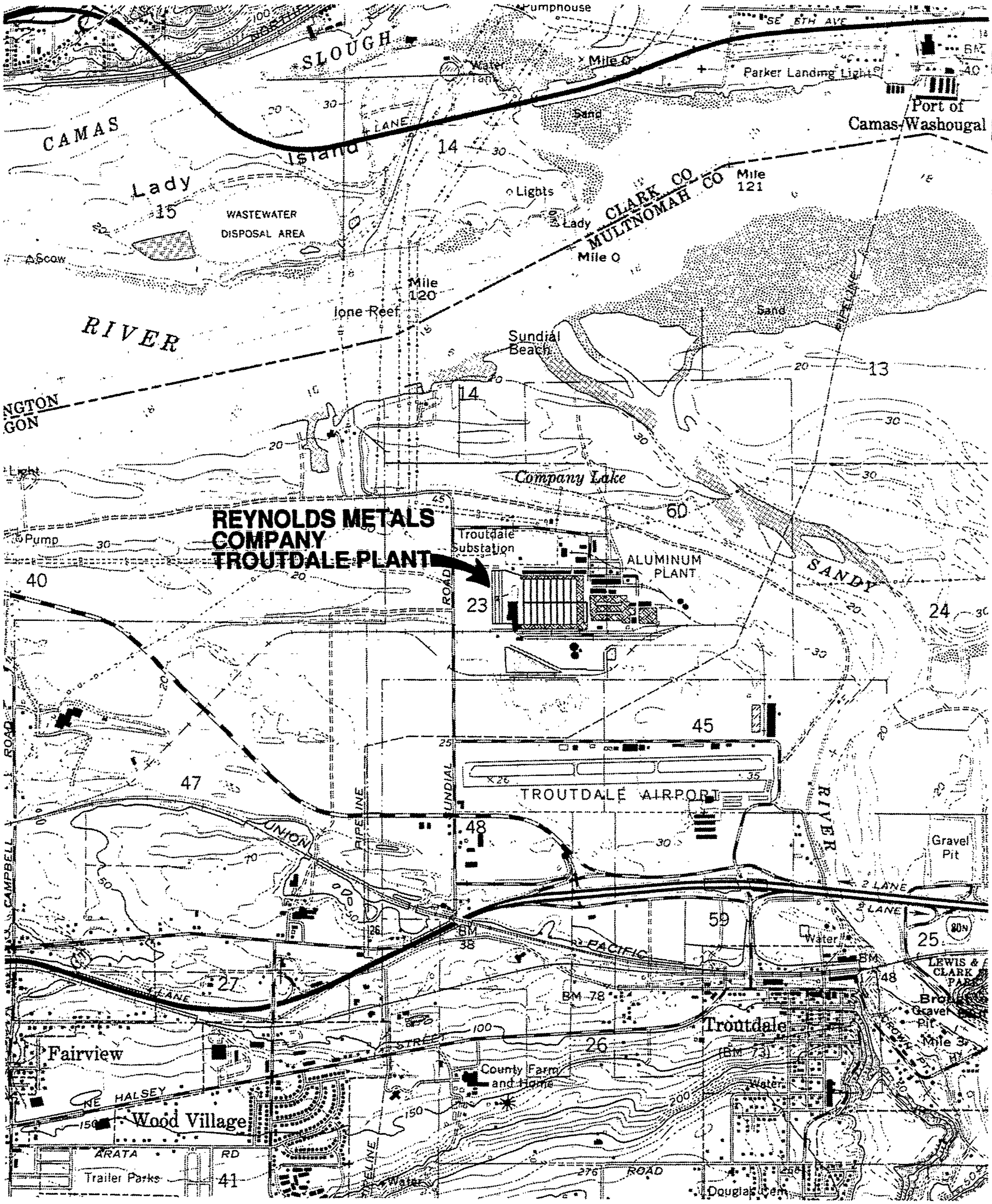

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SCALE IN FEET

Figure 1-1
VICINITY MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

CH2M HILL

9293W07.DWG

This report presents the findings for the RSA of the Troutdale facility. The work is for Operable Unit 1. This site assessment focused on OU1 because it was thought to encompass the primary sources that potentially affect groundwater and the environment.

RSA Work Planning and Site Investigation Activities

EPA authorized its contractor, E&E, to prepare a Quality Assurance Sampling Plan (QASP) (*Technical Assistance Team Sampling Plan for Reynolds Metals Operable Unit One, Troutdale, Oregon* TDD T10-9311-006) to cover the site assessment activities for OU1. The plan was prepared under the presumption that RSA activities would be conducted by E&E. The plan, dated May 27, 1994, was presented to RMC in early June for implementation during the month of June. RMC was offered the opportunity to perform the work itself if the work could be started in June.

RMC elected to undertake the required removal site assessment activities through its contractor, CH2M HILL, under EPA oversight. Following discussions between RMC and EPA, CH2M HILL and RMC immediately developed a preliminary work plan for shallow zone groundwater investigations. Reconnaissance activities were also started by RMC and CH2M HILL to supplement information previously obtained by EPA. As a result of this additional reconnaissance, the original QASP was modified by CH2M HILL to include several additional areas of the plant property for investigations. In addition, some of the analytical and sampling techniques in E&E's QASP were modified with EPA's approval.

Field work for the removal site assessment began on July 7, 1994, and was completed in late September 1994. The results of these field investigations are summarized in this report.

Report Organization

This report is organized in the following manner:

Section 1: Subject and Purpose of Investigation. Provides the report outline and background information on the site and previous investigations.

Section 2: Soil and Debris Areas. Summarizes investigation of the soil and debris areas.

Section 3: Groundwater. Summarizes investigation of the shallow and deep groundwater aquifers.

Section 4: Sediments and Surface Water. Summarizes the results of the surface water and sediment site investigation.

Appendixes: Provides details of the groundwater analyses, data tables for all media, and the QASP. The appendixes are bound separately as Volume 2 of this report.

Background Information

This section provides background information describing the plant, waste handling practices, key site features, and findings for previous site investigations.

Plant Description

This section summarizes information about the plant, the products produced there and the regulatory status of the facility. The information in this section was obtained from the SIP Report and meetings with RMC staff. Whenever noted, inconsistencies or errors in the SIP report were corrected.

Plant Location, Layout, and Operating Status

The Reynolds Metals facility is a primary aluminum reduction plant where alumina (from bauxite) is reduced to aluminum. The plant is within Sections 14 and 22 through 24 of Township 1 North, Range 3 East, Willamette Meridian (45° 33' 07" north latitude, 122° 23' 22" west longitude). It is approximately 1.25 miles north of the City of Troutdale, Oregon.

The Columbia River forms the plant's northern border and the Sandy River forms its eastern border. A U.S. Army Corps of Engineers (COE) flood control dike surrounds the plant on the northern and eastern sides. Site areas north and east of the dike are located within the 100-year floodplain.

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Reduction takes place when electricity is passed from the anode to the cathode through an electrolyte solution of molten cryolite (Na_2AlF_6) and alumina. As the alumina is reduced, the aluminum is separated and settles to the bottom of the pot. At regular intervals, the molten aluminum is siphoned or tapped off and taken to the cast house where it is made into sheet aluminum or foundry ingots of varying sizes. Other metals such as copper, beryllium, and chromium are added to produce various aluminum alloys.

Additional details on the production processes and wastes produced are outlined in the subsections that follow..

Wastewater Treatment Systems

The Troutdale facility operates with two wastewater treatment systems. The main wastewater treatment system is used to treat discharge from the electrostatic precipitators (ESPs) that control air emissions from the carbon bake anode plant. The second plant treats onsite sanitary wastewater only.

The ESP wastewater treatment plant consists of chemical addition, a clarifier, and solids handling equipment. The major constituents in ESP effluent are aluminum, fluoride, and polynuclear aromatic hydrocarbons (PAHs). Calcium chloride is added to the ESP effluent to precipitate constituents and the wastewater is sent to the clarifier for further settling. A flocculent is added at the clarifier to improve settling. The clarifier effluent flows into the collection ditch behind the plant, which is discharged into Company Lake.

The onsite sanitary wastewater treatment plant consists of a primary screen, a biological tower, and an Imhoff Tank. The system is run in batch mode whenever the wet well reaches a set level. Influent is screened to remove large materials and then flows to the outer chamber of the Imhoff tank where solids are allowed to settle. Screened and settled liquid is sent to the biological tower for microbial treatment. A recycle pump keeps the microorganisms on the tower active between batches. Treated water exiting the tower is chlorinated and then piped to the inner chamber of the Imhoff tank. Effluent from the Imhoff tank flows into the collection ditch, which is discharged into Company Lake. Biological solids from the treatment plant are land-applied onsite.

Company Lake is a natural lake with an unconsolidated bottom and is used as part of RMC's wastewater and storm water runoff system. All collected storm water, process cooling water, dewatering water, and wastewater treatment plant effluent is discharged into a collection ditch south of the plant. The water is then pumped to Company Lake.

Plant Regulatory Status. At full capacity, the Troutdale plant is a large quantity hazardous waste generator under the Resource Conservation and Recovery Act (RCRA). Because the plant is not currently operating, the facility was officially granted small quantity generator status in 1993.

The plant operates under a National Pollutant Discharge Elimination System (NPDES) permit administered by the Oregon Department of Environmental Quality (DEQ). The permit covers two outfalls: one for discharge from Company Lake to the Columbia River and the other for the onsite sanitary wastewater treatment plant discharge to the collection ditch south of the plant.

The plant also has an air contaminant discharge permit from DEQ. The current permit expired in March 1993 and a new one has not been issued. However, Reynolds is to comply with the provisions of the old permit until a new one is issued.

Waste Handling Practices

This section describes wastes produced at the plant and historical solid waste disposal practices.

Wastes Produced at the Plant

The SIP report contains a summary of the most significant quantities of waste generated at the Troutdale plant. Estimates of waste production are based on periods of full plant production. The plant has been on standby for the last 3 years and, as previously noted, waste production is minimal.

A number of wastes are produced at the Reynolds plant during the production of aluminum. Twenty-one separate waste streams were identified by Reynolds in response to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) information needs letter. These 21 waste streams originate in the carbon plant, pot rooms, cast house, wastewater treatment plant, or at sites of miscellaneous plant operations.

The carbon plant produces carbon anodes for use in the pots. "Green" carbon blocks are pressed into blocks from a mixture of calcined petroleum coke, coal tar pitch, and crushed remains of used carbon blocks. The carbon blocks are baked in brick-lined pit-type gas-fired furnaces for up to 3 weeks at temperatures up to 1,300°C. Copper rods attached to a cast iron stub are attached to the carbon anodes to suspend the anodes in the reduction cells. Six wastes are produced at the carbon plant: coal tar pitch solids, ESP solids, butt screens, "electromelt" solids, rodding room baghouse dust, and furnace brick.

The pot rooms contain a connected series of electrolytic cells in which molten aluminum is produced. Two major types of solid waste are produced in the pot rooms: potliners and "crust." Potliner is an EPA-listed hazardous waste (RCRA waste K088) (40 Code of Federal Regulations 261.32). Potliners contain significant amounts of iron cyanide and free cyanide (Federal Register, Number 177, page 35416, September 13, 1988). Though the chemical and physical mechanism by which cyanide is formed is poorly understood, it is likely that carbon from the cathode combines with nitrogen from the air.

After continued use, carbon cathode potliners crack, causing the molten aluminum to become contaminated with iron from the cast iron pots. Cracked or "spent" potliners are then broken out of the pots and replaced. At full production, the Troutdale plant produces approximately 4,600 tons of potliner wastes annually.

Crust or "bath" is a solid material that forms above the electrolyte in the pots. Crust is not a waste material because it is reused in the pots depending on the sodium content in the ore. For proper reduction of the ore, a specific ratio of sodium to fluoride must be maintained in the pots. When the ore sodium content is high, fluoride is added to the pots and crust is formed. This crust is periodically removed from the pot and stored for reuse when the ore sodium content is low. Crust that has been stored by the Troutdale facility is currently being sold to another aluminum reduction plant in the Pacific Northwest.

Solid Waste Disposal Practices

Solid wastes are currently disposed of at appropriate facilities. Historically, plant waste materials were placed at various locations throughout the plant site. These waste placement activities were typical of practices performed at industrial plants at the time. Until 1975, spent potliners were placed onsite. In 1975, Reynolds removed approximately 12 million pounds of spent potliner and sent it to the Reynolds aluminum plant in Longview, Washington, for reprocessing. An EPA report indicates that only the aboveground portion of the potliner pile was removed. Between 1975 and 1983, potliners were sent to Longview for reprocessing. Between 1983 and when the plant was shut down in 1991, potliner was handled as a RCRA hazardous waste, and was disposed of at the Chemical Waste Management, Inc., landfill in Arlington, Oregon.

In 1993, a new potliner reprocessing plant owned by Reynolds opened in Gum Springs, Arkansas. RMC has indicated that all future potliner produced by the Troutdale facility will be reprocessed in Gum Springs if a future EPA-proposed potliner land disposal restriction goes into effect. Until this decision is made, potliner generated at the Troutdale facility will continue to be disposed of at the Chemical Waste Management landfill.

Waste materials historically produced by the plant, and that may have been placed on the plant site, are summarized in Table 1-1. The materials are typical of aluminum reduction operations and were specifically investigated during the site reconnaissance and assessment activities discussed in this report.

Key Site Features

The Troutdale plant is located southwest of the confluence of the Sandy and Columbia Rivers, north of the Port of Portland's Troutdale Airport. The site is currently fenced, as indicated in Figure 1-2.

Table 1-1
Summary of Waste Material Physical and Chemical Characteristics

Material	Description	Physical	Chemical
Potliner	Ground or broken remains of cathodes (pots)	Black, solid, rocklike material, although occasionally found pulverized. Typically has an ammonia odor.	PAHs, CN^-, potentially Fl^- and other metals, carbon
Anodes, anode butts, butt screening	Ground remains of anodes	Black, solid, rocklike material. Occasionally found pulverized.	PAHs, metals, carbon
Carbon blocks	Coke solids used to produce potliners and anode blocks	Black, solid, rocklike material.	Carbon
Electromelt solids	Slag-like material removed from furnaces during production of cast iron rods	Metallic, slag-like material	Metals
Coal tar pitch, sludge	Sludge from ESPs attached to carbon bakes	Black sludge or solid tar-like material	PAHs
ESP solids	Solids from ESP bleedwater treatment	Black sludge or solid tar-like material	PAHs
Spent Cryolite	Electrolyte solution used for aluminum production	Blue-grey dust or solid material	Fl^-, other metals. May have PAHs from contact with anodes and cathodes
Capacitors	Capacitors from substation at site	Rectangular metal canisters	PCBs
Plant Debris	Debris from various plant operations	Concrete, building materials, drums, wooden pallets, metal parts, etc.	Inorganics, PCBs (associated with building materials), oil, solvents associated with degreasing operations
Brick/refractory	Liner from carbon bakes, molten aluminum troughs to cast room, and potliner room flooring	Color varies: yellow, brown, to black	Primarily inorganic, although there are no leachable chemical characteristics for bricks themselves.

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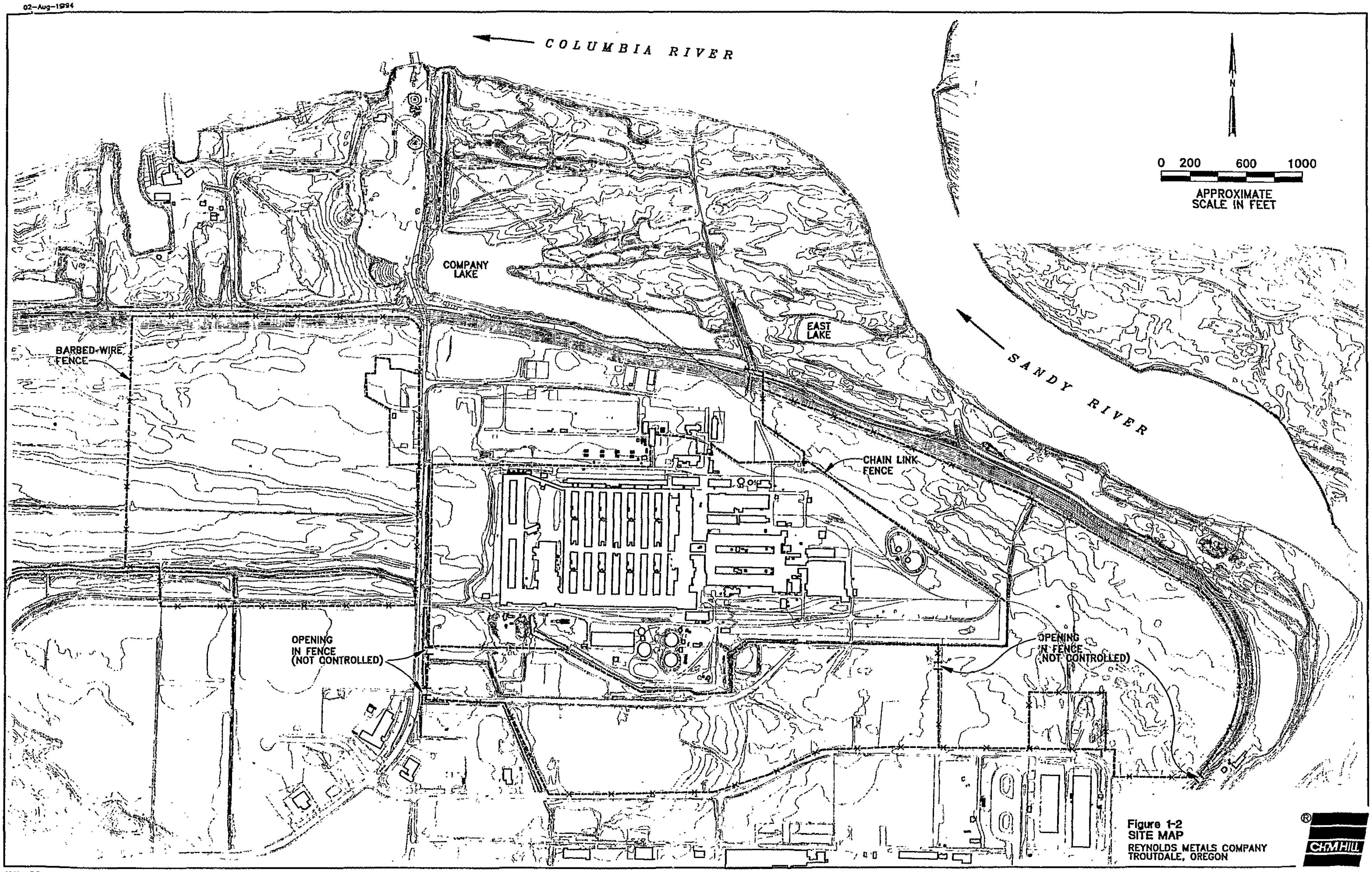

Figure 1-2
SITE MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

CH2M HILL

9293W05.DWG

Topography

The RMC property is dissected by a U.S. Army Corps of Engineers flood control dike that runs approximately east-west through the RMC property, then turns south at the east end of the property. The site is generally flat, with some minor relief toward the south and the northeast corner of the area enclosed by the dike. In general, the plant process buildings occupy the western portion of the site.

Storm drainage from the plant area and paved areas is collected in a storm drain system, and is then piped south of the treatment plant to the collection ditch.

The eastern part of the plant site is generally open fields and storage areas. North of the flood control dike the topography is generally flat, sloping gently toward the river, and transected by numerous small drainages.

Geology

The plant is located near the eastern edge of the Portland Basin, a flat-bottomed, northwest-trending basin with faulted southwestern and northeastern margins. The maximum depth of the basin is estimated to be approximately 1,600 feet.

The site geology consists of quaternary alluvium, underlain by Troutdale formation, underlain by Sandy River Mudstone. Bedrock in the basin is the Columbia River Basalt.

The quaternary alluvium consists of unconsolidated sand, silt, clay and gravel that was deposited on the floodplains and channels of the modern Columbia and Sandy Rivers. Sand and silt are the predominant materials; however, clay and organic material are present in local areas. Post-Missoula flood channels in the Columbia River Valley were cut to depths of up to 150 feet bgs. These recent alluvial deposits are restricted to elevations of less than about 35 feet (National Geodetic Vertical Datum), which is approximately the level of historic floods.

The Troutdale Formation is a Pliocene-to Pleistocene-aged formation consisting of moderately-to-well lithified conglomerates with minor interbeds of sandstone, siltstone, and claystone and volcanic ash and debris flow. The conglomerates generally consist of well-rounded pebbles and cobbles of basalt, andesite, dacite, and metamorphic and plutonic rocks. The sand and silt conglomerate matrix and interbeds contain varying amounts of feldspathic, quartzo-micaceous, and volcanic lithic and vitric sediment. The lithology of the sediments and ratio of the conglomerate to sandstone and siltstone vary widely throughout the area.

On the basis of preliminary information, the surface of the Troutdale Formation has been eroded to a depth of about 150 feet in the immediate vicinity of the plant. Preliminary review of well logs from the plant and adjacent sites show up to 150 feet of unconsolidated alluvium overlying the upper unit of the Troutdale Formation.

The Sandy River Mudstone is a Pliocene-aged unit consisting of moderate to poorly lithified siltstone, sandstone, mudstone and claystone. The material is typically blue-green to gray where fresh and brown to reddish brown where weathered. The dominant mineralogy is quartzo-micaceous. Volcanic ash and pumice layers occur locally.

The Columbia River Basalt group is a series of Miocene-aged tholeitic flood-basalt flows that were erupted from long linear fissure systems in northeastern Oregon, southeastern Washington and western Idaho. Many of the flows are known to be huge in size, often covering tens of thousands of square miles and ranging from tens to thousands of cubic miles in volume. Differences and variations in the geochemical, paleomagnetic, and lithological properties allow this series of basalt flows to be subdivided into five formations.

Summary of Previous Site Investigations Findings

Much of the information in this subsection is summarized from the SIP.

Site Inspection History

A 1980 EPA inspection report, which describes the major waste generation areas at the Reynolds plant, states that potliners had been placed onsite until the Longview plant started potliner recovery operations in 1975. At that time the aboveground potliner pile was shipped to Longview for reprocessing.

Groundwater samples were collected by DEQ staff in 1981 from three onsite wells (numbers 1, 2, and 16) and two offsite production wells (on Fairview Farms property to the west of the site now owned by Reynolds). The screened intervals of the wells were not reported. Samples were analyzed for cyanide and polychlorinated biphenyl (PCB) congeners. Results indicated detectable concentrations of cyanide in onsite wells 1 and 2. None of the offsite wells showed cyanide concentrations above the detection limit of 0.002 milligrams per liter (mg/L). In all samples analyzed for PCBs, this compound was below the detection limit of 0.001 mg/L. No quality control samples were collected.

A 1984 PCB inspection by EPA of the adjacent Bonneville Power Administration (BPA) Troutdale substation found that failed capacitors had been buried on the Reynolds property 10 to 30 years ago. It was estimated that more than 100 capacitors were buried north of the COE dike. A site inspection reassessment report prepared for EPA in 1988 concluded that there is a lack of records detailing past waste disposal practices at Reynolds, and recommended sampling groundwater beneath the site and from wells in the vicinity. The report also recommended sampling Company Lake.

In April 1992, free (liquid) mercury was discovered by Reynolds personnel in the southeast corner of the plant site (storage and scrap yard). Mercury concentrations up to 1,780 milligrams per kilogram (mg/kg) were found in soils. The suspected source of this mercury is the dismantling of old mercury arc rectifiers previously used at the plant. Approximately 600 tons of soil were removed from the site and disposed of by Chemical Waste Management, Inc. Confirmational soil samples were collected after excavation. The maximum mercury concentration in confirmation samples (composed of up to 5 discrete samples) was 32.1 mg/kg.

Agency Site Reconnaissance

On January 20, 1993, PRC personnel under contract to EPA conducted a site reconnaissance of the 80.25-acre plant area. The entire 715-acre site was not canvassed during the 1-day visit, though the majority of the site was viewed during a drive-through with facility personnel. The results of the investigation are summarized in the SIP report. Several areas were discovered that warranted further investigation, as outlined in that report and summarized below.

Conclusions from the Site Inspection Prioritization (SIP) Report

The SIP report listed the following areas at the Reynolds facility as potential sources of hazardous substances:

- Former potliner disposal area (that is, south landfill)
- Former cryolite ponds
- Storage and scrap yard
- Under refractory brick on the north dike
- West bank of the Sandy River
- Unknown waste pile
- Company Lake sediments
- Outfall ditch sediments (south of the main plant)

In addition, groundwater and surface water were sampled and found to contain substances related to the manufacturing processes.

Fieldwork Summary

This section summarizes fieldwork reconnaissance procedures (including observations) and the resulting scope of the OU1 site assessment activities.

Reconnaissance Procedures

Purpose

Prior to conducting site fieldwork, RMC and CH2M HILL conducted a number of reconnaissance activities to determine likely locations for investigation. The purposes of this reconnaissance included:

- Identifying areas of the plant that would likely require investigation based on historical waste placement practices

- Helping to focus the investigations by determining the extent of waste placement

Scope

CH2M HILL and RMC performed four reconnaissance activities to develop the scope of the OU1 site investigations:

1. Previous investigations were reviewed.
2. Aerial reconnaissance photographs were obtained and reviewed.
3. Current and former plant employees were interviewed.
4. The entire plant site and surrounding RMC property were inspected in a walkthrough.

The activities conducted and results of the activities are summarized below.

Previous EPA Investigations

The areas outlined in the SIP report and potentially requiring additional investigation are noted above. In addition, there was insufficient information available regarding the quality or flow direction of the shallow groundwater zone.

In preparing the QASP, E&E outlined the areas for investigation that were considered part of OU1. In addition to the items above, there were allegations made about prior plant waste placement activities that required investigation. The E&E QASP listed the following areas for investigation as part of the OU1 removal site assessment:

- Determine whether spent potliners or other materials are present in an alleged disposal area south of the cryolite ponds. If found, perform a vertical and horizontal extent-of-contamination survey.

- Sample surface and subsurface soil in the cryolite ponds area.

- Determine whether spent potliners are present in the east parking lot. If found, perform a vertical and horizontal extent-of-contamination survey. This investigation was to be made because a former plant employee alleged that spent potliners had been used as fill material.

- Design and install a groundwater monitoring network to determine the depth to groundwater, flow direction, and nature and extent of groundwater contamination.

- Sample surface and subsurface soils in the scrap yard area.

- Conduct a reconnaissance of the floodplain area north of the COE dike and Columbia Rivers and other target areas, documenting observations and taking samples as needed.

- Collect groundwater samples from established onsite production wells.

- Collect sediment samples from Company Lake near the refractory debris pile to investigate allegations that PCB-containing capacitors were buried in the dike.

- Collect sediment and surface water samples from the Company Lake outfall to the Columbia River to determine whether hazardous substances were present.

The items listed above were assumed to be basic requirements for the OU1 investigation.

Aerial Photograph Review

CH2M HILL obtained aerial photographs of the plant vicinity from Reynolds Metals, COE, private aerial survey companies, and the Port of Portland. The series of photographs were from 1939, prior to plant construction, to 1993. The series were in 3- to 10-year increments.

The photographic series was reviewed and EPA was briefed on the findings of the review. The following observations were made by RMC and CH2M HILL:

- Following plant construction and into the mid-1950s, the area known as the south wetlands area appeared to be the point where plant stormwater and wastewater were discharged.

- Spent potliner is believed to have been placed in a location east of the plant site, defined in this report as the "east potliner area." This material was removed before 1977. It is believed that the 12 million pounds of spent potliner removed from the facility in 1975 came from this location.

- The east and west portions of Company Lake were divided by fill for the outfall road in the early 1950s, before industrial effluent was discharged to the west part of the lake.

- Salmon Creek, a small meandering creek, was rerouted several times across the plant property.

- Waste materials were observed to have been placed in the south landfill area. Additionally, the photographs show placement of waste materials in the scrap yard, in an area east of the plant scrap yard, in the wooded wetland area north of the dike, and in an area west of the main plant and east of Sundial Road.

There was no indication that materials had been placed in the east parking lot area, as had been alleged.

- Refractory brick was placed along Company Lake through 1991.
- The cryolite ponds were apparently constructed in the late 1950s.
- There was no information available from the aerial photographs indicating the burial location of any capacitors.

Employee Interviews

Current and former employees of the plant were interviewed to assist in determining areas where wastes were potentially placed. These interviews were conducted formally and informally throughout the response assessment. Interview information was considered essential for investigating the alleged capacitor burial. Allegations about buried capacitors included the north industrial landfill, various locations along the dike, various locations near the BPA substation, south of the north landfill, and east of the carbon plant.

All allegations were investigated; however, no capacitors were found in any of the locations noted during employee interviews.

Site Reconnaissance Walkthrough

Site walkthroughs were made by RMC, CH2M HILL, EPA, and E&E personnel. Waste disposal areas were investigated. In addition, the following observations were made and subsequently investigated:

- Sparse vegetation was noted in an area at the west end and immediately south of the plant. This area, which was generally isolated from the south wetlands area, was subsequently investigated.
- Surficial black, solid material, which was identified by RMC personnel as potentially being spent potliner and electromelt material, was found east of the plant in an area where waste placement may have occurred.
- Potential waste disposal areas were discovered on the outfall road and the COE dike.
- Refractory brick was found in various locations around the plant.

Scope of OU1 Site Assessment Activities

As a result of the reconnaissance, the scope of the OU1 site assessment, as originally outlined by E&E, was broadened by RMC. As part of the arrangement of working with the EPA

Response Branch, RMC also agreed to investigate additional areas observed during the reconnaissance activities that apparently required investigation, including the shallow groundwater. These investigations are described later in this report.

The scope of the OU1 removal site assessment included the bulleted items listed below:

- Determine the nature and extent of material and substances in the following areas:
  - Unknown waste pile (the north landfill)
  - South landfill[1]
  - East potliner area
  - Scrap yard
  - Parking lot area
  - Former cryolite ponds
  - South wetlands area
  - Sparse vegetation area
  - Other miscellaneous areas
- Investigate alleged capacitor placement in the following areas:
  - South landfill
  - Unknown waste pile (the north industrial landfill)
  - Various locations along the dike
  - Near the coke building
- Investigate the potential for hazardous substances in sediments and surface water in the following water bodies:
  - Company Lake
  - Outfall ditch
  - Salmon Creek
- Investigate shallow groundwater quality and flow direction. This involved:
  - Locations potentially downgradient of perceived source areas
  - Locations at the plant site perimeter
- Investigate deep groundwater quality onsite and offsite

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[1]It should be noted that an area south of the plant site, which was termed the "Potliner Disposal Area" in the SIP report, is called the "south landfill" in this report. This change has been made because information available to date (including the results of this RSA report) suggests that this fill area was not necessarily used for disposal of potliner.

Data Validation Summary

Analytical data resulting from site assessment activities were reviewed to determine their appropriate use or usability. This review focused on criteria for the following quality assurance/quality control (QA/QC) parameters and their overall effect on the data:

- Sample holding times
- Method blanks and sensitivity (detection limits and dilution factors)
- Precision, accuracy, and percent completeness
- Field QA/QC procedures (field blanks and sample duplicates)

Overall, soil and groundwater data were found to have met the QC acceptance criteria as outlined in the *Reynolds Metals Company Final Operable Unit 1 Quality Assurance Sampling Plan* (QASP) and are usable for the purposes defined in this RSA report.

Laboratory analyses were completed by North Creek Analytical, Beaverton, Oregon. Laboratory QA/QC procedures were in accordance with standard EPA protocols for each test method.

Use of Standards, Criteria, or Guidelines for Comparison

No comparison against standards is made for soil or sediment analytical results. There are currently no generally accepted health or ecological-based standards, criteria, or guidelines for comparison of the concentrations of substances in soil or sediments at the Troutdale plant.

Analytical results for groundwater are compared against maximum contaminant levels (MCLs) in the data presentation. MCLs are drinking water standards that are enforceable by state and federal regulatory agencies. They were established by EPA under the Safe Drinking Water Act and are listed in 40 CFR 141.61. MCLs represent the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLs are commonly used to evaluate groundwater quality, particularly where the groundwater can be used for drinking water purposes.

It has not been determined that MCLs are an appropriate concentration to evaluate groundwater in the shallow or deep zones at the Reynolds Metals facility. Their use in this report is for screening and comparison purposes only.

Section 2
Soil and Debris Areas

Introduction

This section provides a summary of the results of site investigations related to the soil and debris areas listed in Section 1. EPA's previous work is summarized for each key area. CH2M HILL's work and results are also provided and discussed.

The following key areas were investigated:

- North landfill
- South landfill
- East potliner area
- Scrap yard
- Parking lot
- Cryolite ponds
- South wetlands
- Miscellaneous areas

In addition, a capacitor search using geophysical methods and test pits was also conducted; these site investigation data are discussed at the end of this section.

Field Methods and Analytical Procedures

Field sampling methods and analytical procedures are summarized below for each area investigated. Information related to composite and discrete sampling is also provided.

Sampling

Sampling Methodology

A variety of field sampling methods were used to determine the presence of substances and debris. Different sampling and investigation methods were used depending on the area sampled and purpose of the investigation. The field test methods used, the rationale for their use, and the areas in which they were used are outlined in Table 2-1.

Discrete versus Composite Samples

Soil and debris area sampling methods and analytical techniques were presented in the QASP. Both discrete and composite sampling methods were used. Composite sampling provided a cost-effective way of determining the general characteristics of an area. Discrete sampling

Table 2-1
Field Test Methods

Method	Description	Rationale for Use	Areas Used
Stainless Steel Spoons	Stainless steel spoons used to take surface and test pit sidewall samples and to remove samples from other sampling equipment.	Collect soil sample from test pit excavation or surface sampling location	All areas
Hand Augering	Stainless steel hand augering tool used to bore hole from surface down to desired sampling depth	Convenience, areas where site access prevented larger equipment from being used. Preferred method for cost.	Cryolite ponds South wetlands Sparse vegetation area
Test Pits	Test pits excavated using backhoe. Pits typically 1' to 14' deep, 3'-4' wide, and 10'-12' long	Best method to achieve required depth and to visually observe excavated material and test pit sidewall.	North landfill South landfill East potliner Scrapyard West field Under utility lines
Geoprobe	1-1/4"-diameter stainless steel tube pushed through desired sampling interval using truck-mounted apparatus	To minimize size of hole and surface disruption. Quick, reliable method to take many samples over a large area.	East parking lot
Electrical Resistivity	Electrical resistivity meter to measure surface and subsurface resistivity.	To help delineate vertical and lateral extent of material and debris by measuring resistance anomalies and variances. Anomalies were also investigated for buried capacitors.	South landfill
Electromagnetometer	Magnetic gradiometer used to measure magnetic flux	For capacitor search; to find strong magnetic fields and magnetic anomalies potentially related to buried capacitors.	North landfill (east side) Under utility lines West field (BPA property)

provided more specific profiling information where the specific pattern of substance distribution was deemed important.

The decision to use composite or discrete, or both types of sampling during the site investigation was made on the basis of the area being sampled and the objectives for that area. Specifically:

- There were a number of areas sampled, including the north and south landfills that consisted of randomly placed heterogeneous fill. For these areas, the objective of sampling was to develop general characterization data. This was accomplished by excavating a large number of test pits, compositing the samples vertically, and testing for a wide variety of constituents. Because of the variable nature of fill material, this was judged to be the best method for sampling and analysis.

- There were areas sampled where the constituents present were believed to have resulted from the general deposition, discharge, or placement of a specific substance or material. Examples of these areas include the east potliner area, south wetlands, and the parking lot. For these areas, discrete and composite samples were collected to evaluate the specific depositional pattern of the constituents present.

To assist in identifying the locations of the buried capacitors, in areas where composite sampling revealed the presence of PCBs, discrete samples were also analyzed to determine the specific location and type of PCB aroclor present.

Analytical Procedures

Analyses performed, rationale for their use, and areas used are summarized in Table 2-2. More specific discussion of analytical procedures and corresponding QA/QC procedures are provided in the QASP.

Standard protocols used during the site investigation involved initially submitting all composite and selected discrete soil samples to the laboratory for screening-level analysis of soluble fluoride, total cyanide, total PAHs, and total PCBs. Screening results were evaluated and, if required by the QASP or otherwise deemed necessary, follow-up confirmational analyses for "species" identification were conducted. For example, total PCBs were detected at a concentration of 0.7 mg/kg in composite sample SW1-C collected from the south wetlands area. Follow-up confirmational analyses identified the presence of Aroclors 1242 and 1260 in a discrete surface soil sample from this location.

Test results for some samples analyzed using the screening methods revealed constituent concentrations "greater than" a given value. This occurred on samples with analyte concentrations that exceeded the linear range of the specific laboratory instrument being used. Because of the rapid laboratory turnaround required on this project, samples were not diluted any further to bring analyte concentrations within the linear range of the instrument. Instead, these test results were flagged by the laboratory with a "greater than" sign (>) and issued as

Table 2-2
Summary of Laboratory Analyses Performed

Constituent	Procedure	Rationale for Use	Areas Used
Total cyanide	EPA 9010	Associated with spent potliner	All
Fluoride	EPA 340.2 modified	Associated with cryolite, spent potliner, general deposition	All
Total polynuclear aromatic hydrocarbons (PAHs)	EPA 8270 modified	Associated with anodes, spent potliner, carbon plant waste	All
PAH species	EPA 8270 modified	To speciate the PAHs that were encountered. Performed on 10 percent of the PAH samples.	All (10% of samples)
Total polychlorinated biphenyls (PCBs)	EPA 8080 modified	Generally associated with heavy electrical equipment. Historically used as a stabilizing agent for other materials; may be associated with building siding material, asphalt, and other debris.	All
PCB species *(Aroclors)*	EPA 8080 modified	To determine the aroclor number (weight percentage of chlorine) of PCBs. Can assist in determining the source or historical usage of PCBs that are found.	All (10% of samples)
Solvents	EPA 8240	Required for disposal characterization. Used for metal degreasing and cleaning. Commonly found at industrial facilities.	North landfill (east side)
Toxicity characteristic leaching procedure (TCLP) metals	EPA 1311, 6010, 7000 series	Required for disposal characterization. Measure of leachable metals.	North landfill (east side)
Priority pollutant metals (13 metals)	EPA 6010, 7000 series	Associated with reduction processes and general industrial operations. Would be associated with waste materials from reduction processes.	All
EPA scan metals (23 metals)	EPA 6010, 7000 series	Associated with reduction processes and general industrial operations. Would be associated with waste materials from reduction processes.	Fairview Farms

Table 2-2
Summary of Laboratory Analyses Performed

Constituent	Procedure	Rationale for Use	Areas Used
Chlorinated pesticides	EPA 8080	May be associated with historical uses to control plant or animal pests at plant and in the general plant vicinity. May be associated with agricultural operations in the area. Detected in PRC investigation.	South wetlands Sparse vegetation area
Total petroleum hydrocarbons (TPH)	Method 418.1 modified	Associated with gas or oils commonly used in industrial operations. Includes gasoline, kerosene, fuel oils, gas oils, lubricating oils, asphalt. Many uses.	South wetlands South landfill North landfill
TPH diesel (TPH-D)	Method 418.1 modified	Diesel oil fraction of the total petroleum hydrocarbons. Used as fuel for diesel engines and firing carbon bakes.	South wetlands South landfill North landfill
Total organic carbon (TOC)	EPA 9060 modified	Measure of the carbon content of a sample. Useful to determine the amount of organic material in a sample. Organic source could be decayed plant material, process material such as carbon blocks.	Fairview Farms

final to CH2M HILL. Instrument calibration concentration ranges are determined by the specific analytical method.

Investigation Results

This section summarizes the results of investigations conducted for this site assessment. Information for each area investigated is summarized as follows:

- Summary of previous sampling
- Work performed
- Field observations
- Summary of sampling results

This section concludes with a discussion of miscellaneous areas and the capacitor search. Sample locations for all areas are shown in Figures 2-1, 2-2, and 2-3.

North Landfill

The north landfill site investigation area is shown in Figure 2-1. This area was identified as a potential concern in the Final SIP report prepared by EPA on October 19, 1993.

The north landfill was divided into two areas for investigation. These portions of the north landfill are located east and west, respectively, of the outfall road. The east area was investigated to determine the extent of a known waste disposal area. Field reconnaissance completed during excavation in the east area identified the presence of additional fill material west of the outfall road. Test pits were excavated in the west area in July 1994. Analytical results for samples collected in this area are provided in Tables 2-3, 2-4, and 2-5.

Summary of Previous Sampling

At the time of the SIP report, the northeast area was identified as the "unknown waste pile." EPA contract personnel collected two samples, WP-01 and WP-02, for analysis. These samples identified metals, SVOCs (specifically PAHs), and two volatile organic compounds (acetone and methylene chloride). Maximum sample concentrations of cyanide and fluoride were detected at 1.5 and 4,830 mg/kg, respectively.

Work Performed

Test pits were excavated by CH2M HILL in the east and west portions of the north landfill. Nine test pits were initially excavated in the east area in June 1994. Eight test pits were excavated in the west area in July 1994.

Test pits were excavated in both areas to native ground surface where possible. A Case 580 Extendahoe was used for test pit excavations and the backhoe reach was limited to about 14 feet bgs. Each test pit was logged and soil samples collected.

SRB 9293W01.DWG
17-Oct-1994

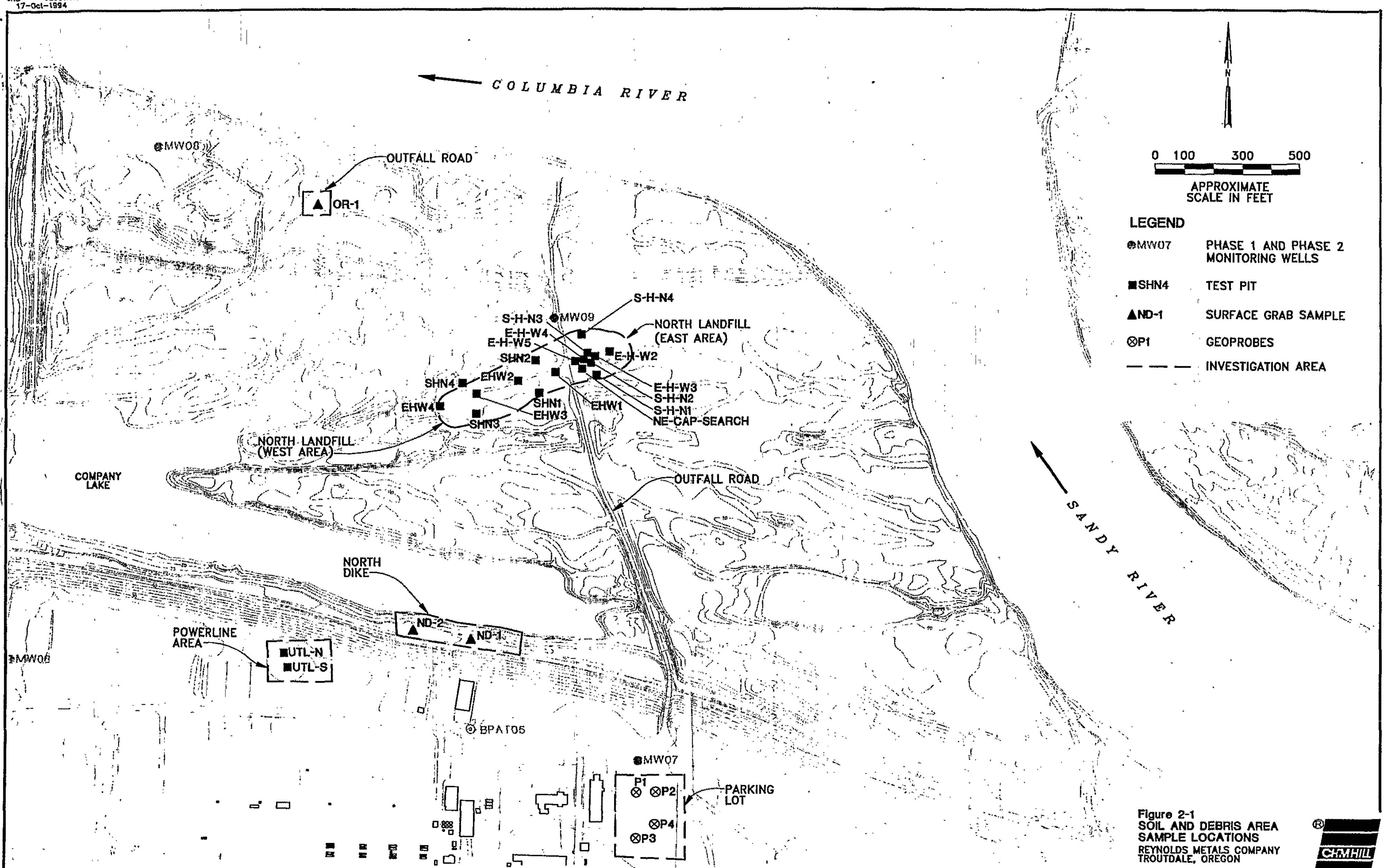

Figure 2-1
SOIL AND DEBRIS AREA SAMPLE LOCATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

CH2MHILL

9293W01.DWG

SRB 9293W02.DWG
09-JAN-1995

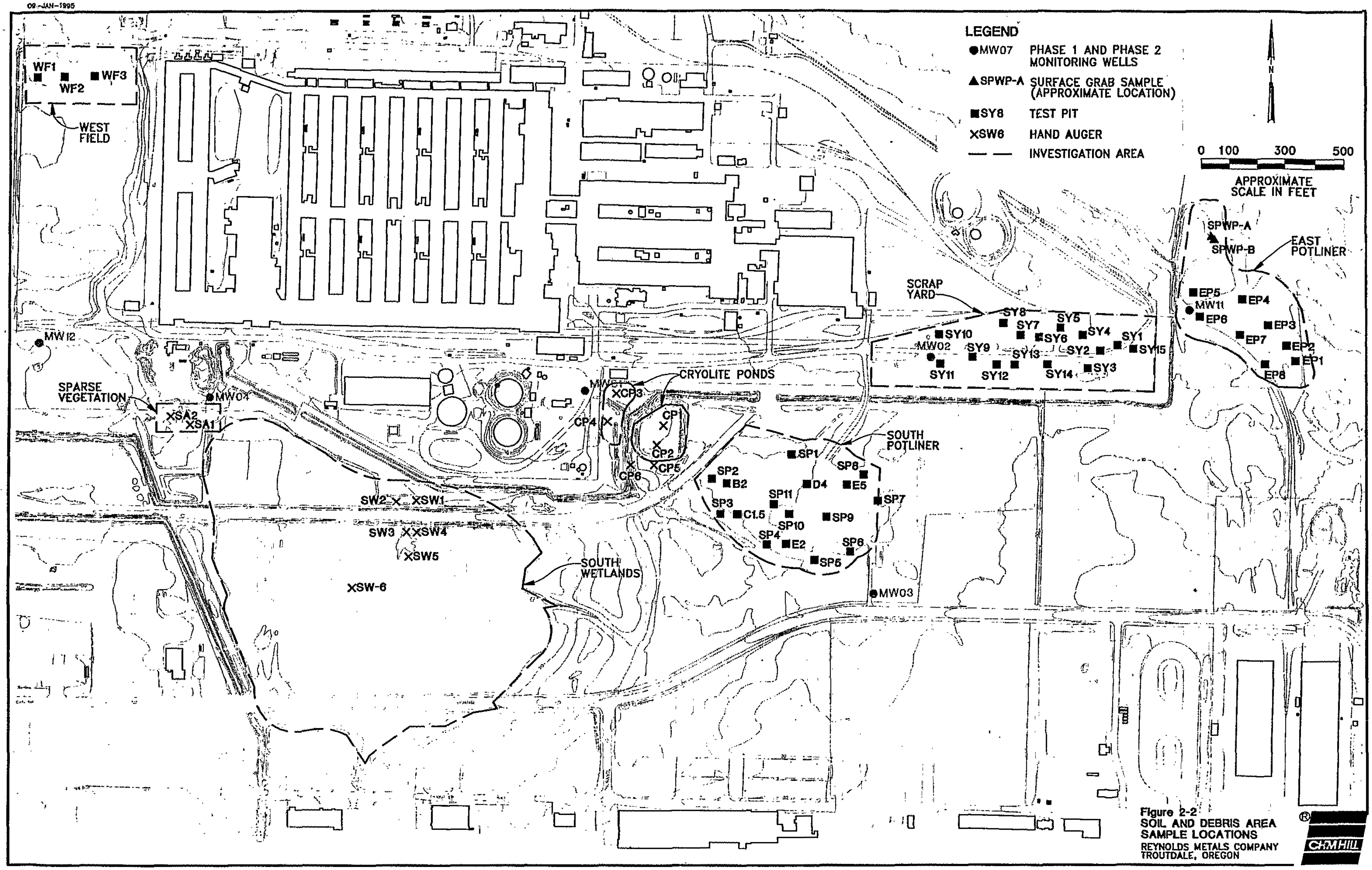

Figure 2-2
SOIL AND DEBRIS AREA
SAMPLE LOCATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

9293W02.DWG

Table 2-9
Parking Lot Analytical Results

Sample Id	P1-1-3		P1-3-5		P1-5-7		P2-1-3		P2-3-5		P2-5-7		P3-1-3		P3-3-5		P3-5-7		P4-1-3		P4-3-5		P4-5-7	
Metals																								
Cyanide, Total	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Organics																								
Total PAHs	0.2	U	1	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1	U	0.2	U	0.2	U	0.2	U	0.2	U
Total PCBs	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U

Units = mg/Kg
U = non detects
> = greater than
Blank space = not analyzed

Table 2-10
Cryolite Ponds Analytical Results

Sample Id	CP1-5.0		CP1-C		CP2-10.5		CP2-C		CP3-S		CP3-1.2		CP4-S		CP4-2.5		CP5-3.0		CP5-C		CP6-3.0		CP6-C	
Inorganics																								
Fluoride	1800				2100				1400		750		1600		820		18		16		38		29	
Cyanide, Total			4.9		7.6		4		100		2.7		18		0.56				0.12				1.3	
Organics																								
Total PAHs			12		25		61		0.92		0.2	U	3.5		0.2	U			0.2	U			0.2	U
Total PCBs			0.2	U	0.8	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U			0.2	U			0.2	U
Metals																								
Antimony			6.5				7.4				2.5	U			2.5	U			2.5	U			2.5	U
Arsenic			20				25				1.4				3.8				1.1				1	U
Beryllium			16				19				1	U			1	U			1	U			1	U
Cadmium			2.3				2.6				1	U			1	U			1	U			1	U
Chromium			16				40				9.7				12				7.8				8.7	
Copper			160				430				22				37				40				18	
Lead			73				78				10	U			10	U			10	U			10	U
Mercury			0.25	U			0.25	U			0.25	U			0.25	U			0.25	U			0.25	U
Nickel			370				430				40				140				12				5.7	
Selenium			2	U			2	U			1	U			1	U			1	U			1	U
Silver			1	U			1	U			1	U			1	U			1	U			1	U
Thallium			1	U			1	U			1	U			1	U			1	U			1	U
Zinc			76				110				17				26				26				21	

Units = mg/Kg

U = non detects

Blank space = not analyzed

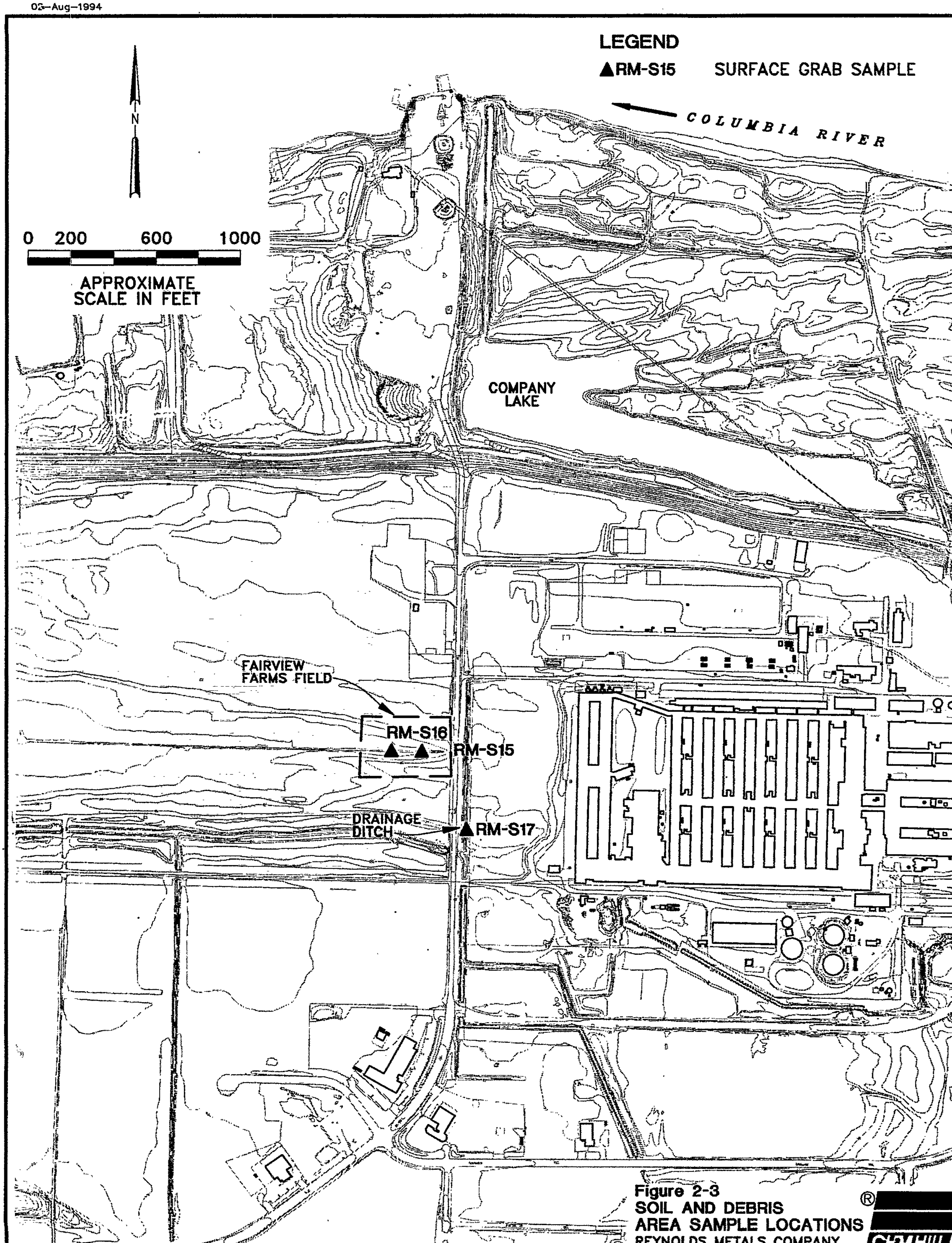

Figure 2-3
SOIL AND DEBRIS
AREA SAMPLE LOCATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

Table 2-3
North Landfill
East Area Analytical Results

Sample ID	S-H-N2/ E-H-W1	S-H-N4	E-H-W1-5/ S-H-N1-3	E-H-W4/ E-H-W3	S-H-N2
Inorganics					
Cyanide (total)	1.1				
Organics					
1. Polycyclic Aromatic Hydrocarbons (PAHs)					
Acenaphthene			50U	5U	
Acenaphthylene			50U	5U	
Anthracene			50U	5U	
Benzo(a)anthracene			190	5U	
Benzo(a)pyrene			280	5U	
Benzo(b)fluoranthene			350	5U	
Benzo(g,h,i)perylene			190	5U	
Benzo(k)fluoranthene			100	5U	
Chrysene			280	5U	
Dibenzo(a,h)anthracene			50U	5U	
Fluoranthene			320	5U	
Fluorene			50U	5U	
Indeno(1,2,3-cd)pyrene			190	5U	
2-Methylnaphthalene			50U	5U	
Naphthalene			50U	5U	
Phenanthrene			140	5U	
Pyrene			310	5U	
2. Polychlorinated Biphenyls (PCBs) (mg/kg)					
PCB 1016			0.5U	0.5U	
PCB 1221			0.5U	0.5U	
PCB 1232			0.5U	0.5U	
PCB 1242			0.5U	0.5U	
PCB 1248			0.5U	0.5U	
PCB 1254			0.5U	0.5U	
PCB 1260			6.9	0.068	
3. Solvents (mg/kg)					
Acetone			0.25U		
Benzene			0.05U		
n-Butyl Alcohol			2.5U		
Carbon Disulfide			0.05U		
Carbon Tetrachloride			0.05U		
Chlorobenzene			0.05U		
Cyclohexanone			1.0U		

Units = mg/kg
U = nondetects
Blank Space = not analyzed

Table 2-3 North Landfill East Area Analytical Results					
Sample ID	S-H-N2/ E-H-W1	S-H-N4	E-H-W1-5/ S-H-N1-3	E-H-W4/ E-H-W3	S-H-N2
1,2-Dichlorobenzene			0.05U		
Dichlorodifluoromethane			0.15U		
Ethyl Acetate			0.05U		
Ethyl Ether			0.05U		
Ethylbenzene			0.05U		
Isobutyl Alcohol			1.0U		
Isopropyl Alcohol			1.0U		
Methyl Ethyl Ketone			0.2U		
Methyl Isobutyl Ketone			0.15U		
Methylene Chloride			0.15U		
Tetrachloroethene			0.05U		
Toluene			0.05U		
1,1,2-Trichloro-1,2,2-trifluoroethane			0.05U		
1,1,1-Trichloroethane			0.05U		
1,1,2-Trichloroethane			0.05U		
Trichloroethene			0.05U		
Trichlorofluoromethane			0.05U		
Xylenes (total)			0.05U		
4. Total Petroleum Hydrocarbons (TPA)				120	
5. TCLP Metals (mg/L)					
Arsenic	0.5U	0.5U	0.5U		
Barium	0.62	0.57	0.52		
Cadmium	0.02U	0.02U	0.02U		
Chromium	0.02U	0.02U	0.02U		
Lead	0.2U	0.2U	0.2U		
Mercury	0.0005U	0.0005U	0.0005U		
Selenium	0.025U	0.25U	0.25U		
Silver	0.02U	0.02U	0.02U		
6. Asbestos (percent)					80

Units = mg/kg
U = nondetects
Blank Space = not analyzed

Table 2-4
North Landfill
East Area Analytical Results
Additional PCB Analysis

Sample ID	S-H-N1	S-H-N2	S-H-N3	E-H-W1	E-H-W2	E-H-W3	E-H-W4	E-H-W5
PCBs (mg/kg)								
PCB-1016	0.25U	0.10U	0.50U	0.50U	0.05U	5.0U	0.25U	0.25U
PCB-1221	0.50U	0.20U	1.0U	1.0U	0.10U	10U	0.50U	0.50U
PCB-1232	0.25U	0.10U	0.50U	0.50U	0.05U	5.0U	0.25U	0.25U
PCB-1242	0.25U	0.10U	0.50U	0.50U	0.05U	5.0U	0.25U	0.25U
PCB-1248	0.25U	0.10U	0.50U	0.50U	0.05U	5.0U	0.25U	0.25U
PCB-1254	0.25U	0.33	1.2	0.50U	0.068	5.0U	0.82	0.25U
PCB-1260	2.6	1.2	12	4.5	0.84	31	13	1.4

Units = mg/kg
U = nondetects
Blank Space = not analyzed.

Table 2-5
North Landfill West Area Analytical Results

Sample Id	EHW1-S		EHW1-2		EHW1-5		EHW1-C		EHW2-S		EHW2-2		EHW2-5.5		EHW2-C		EHW3-C		SHN1-C		SHN2-C		SHN3-C		SHN4-C	
Inorganics																										
Cyanide, Total							0.32								1.6		1		0.3		0.18		0.14		0.1	U
Fluoride							25								490		250		36		26		40		17	
Organics																										
Total PAHs							0.2	U							1400	>	140		0.2	U	6.3		1.9		11	
Total PCBs	1.3		2		24		4		5.1		11		28		3.2		1.2		0.2	U	0.2	U	0.2	U	0.2	U
Metals																										
Antimony							2.5	U							3.1		2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
Arsenic							1.9								8.2		4.1		8.3		7.2		3.8		2.1	
Beryllium							1	U							2.7		1	U	1	U	1	U	1	U	1	U
Cadmium							1	U							1.3		1	U	1.3		1.5		1	U	1	U
Chromium							10								28		15		23		20		22		16	
Copper							23								1300		1600		69		46		50		31	
Lead							10	U							76		30		23		23		23		16	
Mercury							0.25	U							0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
Nickel							9.2								55		38		25		24		51		19	
Selenium							1	U							1	U	1	U	1	U	1	U	1	U	1	U
Silver							1	U							1	U	1	U	1	U	1	U	1	U	1	U
Thallium							1	U							1	U	1	U	1	U	1	U	1	U	1	U
Zinc							39								180		90		100		120		70		72	

Units = mg/Kg
U = non detects
> = greater than
Blank space = not analyzed

In the east area, discrete samples were collected from soil stockpiled adjacent to each test pit. Individual discrete samples having similar visual characteristics were composited for analysis. Analytes were selected for these soil samples primarily to characterize the material for possible removal and offsite disposal. Analytical procedures included cyanide, solvents, total petroleum hydrocarbons (TPH), PCB aroclors, PAHs, toxicity characteristic leaching procedure (TCLP) on eight Resource Conservation and Recovery Act (RCRA) metals, and asbestos (one sample). Following review of composite test results, one composite sample from each east area test pit was submitted for PCB analysis.

Soil samples from test pits in the west area were collected from the exposed wall surface of each excavation. Up to three discrete samples were collected from each test pit at approximately surface, mid-depth, and full depth locations. The individual discrete samples were composited at test pits EHW1, EHW2, EHW3, SHN1, SHN2, SHN3, and SHN4 and analyzed for cyanide, fluoride, priority pollutant metals, PAHs, and PCBs. On the basis of the composite sample analyses, discrete samples from EHW1 and EHW2 were also analyzed for PCBs to aid in characterizing the waste material.

Field Observations

Fill material in the east area consisted primarily of carbon waste, refractory brick, and miscellaneous debris. Anode blocks were visually identified in E-H-W2, and black oily silts with a diesel smell were identified at the bottom of E-H-W4. A diesel smell was also noted in the bottom of S-H-N3. Ash was identified in the northernmost test pit at S-H-N4. A small amount of an unknown blue and white material was found in several locations during the excavations. Asbestos was also identified in a sample of debris tested from S-H-N2.

Several of the test pit excavations encountered the edges of the waste material. The locations of the edges were then determined by topographic survey. Fill depth just east of the outfall road exceeded 12 feet. Fill depth generally decreased to the east: it was about 9 to 10 feet in test pits E-H-W2 and E-H-W3 and 5 feet at E-H-W1. Fill depth also decreased in the north and south directions, decreasing to about 5 feet in the southernmost test pit. Additional debris, including piles of fill and some old drums, was identified in brush approximately 50 feet south of the northeast area.

Fill in the west area was more heterogeneous than in the east area and contained larger amounts of miscellaneous debris and solid waste. Large amounts of refractory brick, wood, and black silty sand were identified in the center of the fill area. A diesel smell was detected at the bottom of EHW2. EHW3 contained old drums, plastic, wire cable, and solid waste. Brick and flue caps were detected in EHW4.

Several of the west area test pit excavations encountered the edges of the waste material. The locations of the edges were determined by topographic survey. The depth of fill in the center of the west area at EHW3 exceeds 14 feet. The depth of fill at the west and east ends is estimated to be about 5 feet.

Summary of Sampling Results

Cyanide was measured in the east area in composite S-H-N2/E-H-W1 at 1.1 milligrams per liter (mg/L). TCLP metals in this sample were all nondetectable, except barium at 0.62 mg/L. Composite E-H-W1-5/S-H-N1-3 contained individual PAHs at concentrations up to 350 mg/kg and PCB Aroclor 1260 at 6.9 mg/kg. This sample also had no detectable solvents and no detectable TCLP metals, except barium at 0.52 mg/L. Composite E-H-W4/E-H-W3 contained TPH at 120 mg/kg, PCBs at 0.068 mg/kg, and no detectable PAHs. A cloth sample from S-H-N2 was found to contain 80 percent asbestos. Finally, a sample from S-H-N4 contained no detectable TCLP metals except barium at 0.57 mg/L.

Test results for the west area of the north landfill are presented in Table 2-5. PAHs were detected in composite sample EHW2 at a concentration of greater than 1,400 mg/kg. Soil samples analyzed from the west area generally contained cyanide in concentrations up to about 1.6 mg/kg, fluoride concentrations less than about 500 mg/kg, PCB concentrations ranging from nondetect to 28 mg/kg, and metal concentrations as shown in Figure 2-2. Peak PCB concentrations of 24 mg/kg and 28 mg/kg were detected in discrete samples EHW1-5 (5 foot depth) and EHW2-5.5 (at 5.5 foot depth).

South Landfill

RMC is alleged to have historically used the south landfill for disposal of spent potliners and other miscellaneous waste materials. The current site investigation activities were conducted in order to characterize the waste material present in this area. Analytical results from this sampling effort are provided in Table 2-6.

Summary of Previous Sampling

EPA contract personnel collected five soil samples approximately 1 foot bgs. Sample results indicate the presence of metals, cyanide, fluoride, PAHs, and pesticides.

Work Performed

Eleven test pits (SP1 to SP11) were initially excavated, in July 1994, in the south landfill to characterize the remnant waste material. Five additional test pits were excavated in September 1994 at electrical resistivity grid positions to correlate the results of an electrical resistivity (ER) survey (discussed later). These test pits are identified by grid position (B2, C1.5, D4, E2, and E5).

Test pits were excavated to native material. Discrete soil samples were collected from the test pit walls at the surface, 2.5 to 3 feet bgs, and deeper where possible. Composite soil samples from each test pit were analyzed for cyanide, fluoride, total PAHs, total PCBs, and priority pollutant metals. Composite samples from test pits SP2, SP4, SP6, B2, C1.5, D4, E2, and E5 were also analyzed for individual PAH species. Composite SP1-6 was analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	B2-2		B2-4		B2-6		B2-C		C1.5-6		C1.5-C		D4-6		D4-8		D4-C		E2-C		E5-C	
Inorganics																						
Cyanide, Total							4.3				44						8.1		4.4		4.6	
Fluoride							670				910						330		710		560	
Organics																						
Total PAHs	0.2	U	1.1		0.2	U	52		120		430		0.2	U	0.2	U	310		180		560	
Acenaphthene	0.0067	U	0.0067	U	0.0067	U	0.48		1.1	U	0.16		0.0067	U	0.0067	U	0.095		1.6		10	
Acenaphthylene	0.0067	U	0.0067	U	0.0067	U	0.067	U	1.1	U	0.14	U	0.0067	U	0.0067	U	0.067	U	0.067	U	0.34	U
Anthracene	0.0067	U	0.0067	U	0.0067	U	0.56		8.8		1.8		0.0067	U	0.0067	U	1.2		2.9		23	
Benzo(a)anthracene	0.0067	U	0.065		0.0067	U	4.5		160		27		0.0067	U	0.0067	U	28		38		100	
Benzo(a)pyrene	0.0067	U	0.081		0.0067	U	6		54		12		0.0067	U	0.0067	U	17		33		110	
Benzo(b)fluoranthene	0.0078		0.19		0.0067	U	10		190		34		0.012		0.0067	U	38		64		160	
Benzo(g,h,i)perylene	0.0067	U	0.096		0.0067	U	6.4		340		11		0.0067	U	0.0067	U	12		29		61	
Benzo(k)fluoranthene	0.0067	U	0.052		0.0067	U	2.8		32		0.14	U	0.0067	U	0.0067	U	0.067	U	23		54	
Chrysene	0.0067	U	0.18		0.0067	U	6.7		280		40		0.01		0.0067	U	28		46		110	
Dibenzo(a,h)anthracene	0.0067	U	0.021		0.0067	U	1.8		11		3.2		0.0067	U	0.0067	U	4.2		7.3		20	
Fluoranthene	0.0067	U	0.077		0.0067	U	6.1		250		44		0.013		0.0067	U	40		33		160	
Fluorene	0.0067	U	0.0067	U	0.0067	U	0.15		1.1	U	0.14	U	0.0067	U	0.0067	U	0.067	U	0.88		6.8	
Indeno(1,2,3-cd)pyrene	0.0067	U	0.092		0.0067	U	6.3		31		9.4		0.0067	U	0.0067	U	11		30		67	
Naphthalene	0.0067	U	0.0067	U	0.0067	U	0.12		1.1	U	0.14	U	0.0067	U	0.0067	U	0.067	U	0.23		3.4	
Phenanthrene	0.0067	U	0.015		0.0067	U	2.5		40		9.8		0.01		0.0067	U	4.8		15		110	
Pyrene	0.0067	U	0.11		0.0067	U	6.1		290		48		0.014		0.0067	U	46		36		140	
PCBs																						
Total PCBs			0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.37		1.1	
Aroclor 1016			0.05	U	0.05	U			0.05	U			0.05	U	0.05	U						
Aroclor 1221			0.1	U	0.1	U			0.1	U			0.1	U	0.1	U						
Aroclor 1232			0.05	U	0.05	U			0.05	U			0.08	U	0.05	U						
Aroclor 1242			0.05	U	0.05	U			0.05	U			0.05	U	0.05	U						
Aroclor 1248			0.05	U	0.05	U			0.05	U			0.05	U	0.05	U						
Aroclor 1254			0.05	U	0.05	U			0.05	U			0.05	U	0.05	U						
Aroclor 1260			0.05	U	0.05	U			0.21				0.05	U	0.05	U						
TPH																						
Diesel																						
Gasoline																						
Heavy/Bunker																						

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	B2-2		B2-4		B2-6		B2-C		C1.5-6		C1.5-C		D4-6		D4-8		D4-C		E2-C		E5-C	
Metals																						
Antimony							2.5	U			31						2.5	U	2.5	U	3.9	
Arsenic							1.3				18						1	U	2.9		5.6	
Beryllium							1	U			9.1						1	U	1	U	1	U
Cadmium							1	U			2.8						1	U	1	U	1	U
Chromium							9.2				220						26		22		44	
Copper							2900				36000						180		440		3100	
Lead							83				350						57		19		34	
Mercury							0.2	U			0.2	U					0.2	U	0.2	U	0.2	U
Nickel							4.6				290						40		110		80	
Selenium							1	U			1	U					1	U	1	U	1	U
Silver							1	U			1	U					1	U	1	U	1	U
Thallium							1	U			1	U					1	U	1	U	1	U
Zinc							22				420						60		60		41	

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	SP1-C		SP2-2.5		SP2-5.0		SP2-C		SP3-C		SP3-CD		SP4-3.0		SP4-C		SP5-3.0		SP5-C		SP6-3.0		SP6-C	
Inorganics																								
Cyanide, Total	1.6						3.6		0.92		1.9				0.1	U			0.44				0.98	
Fluoride	410						1000		8.2		6.1				150				62				170	
Organics																								
Total PAHs	10000	>	0.2	U	0.2	U	80		0.2	U	0.2	U	0.2	U	23		0.2	U	14		0.2	U	670	
Acenaphthene							0.28								0.24									
Acenaphthylene							0.028								0.0067	U								
Anthracene							0.6								0.38									
Benzo(a)anthracene							3.6								1.9									
Benzo(a)pyrene							3.5								2.2									
Benzo(b)fluoranthene							7.4								3									
Benzo(g,h,i)perylene							4								1.9									
Benzo(k)fluoranthene							2.8								1.1									
Chrysene							7.4								2.2									
Dibenzo(a,h)anthracene							0.94								0.43									
Fluoranthene							5.1								3.3									
Fluorene							0.14								0.16									
Indeno(1,2,3-cd)pyrene							3.6								1.9									
Naphthalene							0.16								0.056									
Phenanthrene							2.8								1.8									
Pyrene							5.6								2.7									
PCBs																								
Total PCBs	0.5	U					0.2	U	0.2	U	0.2	U			0.2	U			0.2	U			0.2	U
Aroclor 1016																								
Aroclor 1221																								
Aroclor 1232																								
Aroclor 1242																								
Aroclor 1248																								
Aroclor 1254																								
Aroclor 1260																								
TPH																								
Diesel	250	U																						
Gasoline	100	U																						
Heavy/Bunker	2700																							

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	SP1-C	SP2-2.5	SP2-5.0	SP2-C	SP3-C	SP3-CD	SP4-3.0	SP4-C	SP5-3.0	SP5-C	SP6-3.0	SP6-C
Metals												
Antimony				5.5	2.5 U	2.5 U		30		2.5 U		2.5 U
Arsenic				6.5	1 U	1 U		7.9		3.1		1 U
Beryllium				8.1	1 U	1 U		2.8		1 U		1 U
Cadmium				2	1 U	1 U		4.2		1 U		1 U
Chromium				51	4.5	4.8		49		13		11
Copper				1100	310	600		2200		450		220
Lead				81	10 U	10 U		120		10 U		10 U
Mercury				0.25 U	0.25 U	0.25 U		0.25 U		0.25 u		0.25 U
Nickel				100	3.3	4.4		79		15		17
Selenium				1 U	1 U	1 U		1 U		1 U		1 U
Silver				1 U	1 U	1 U		1 U		1 U		1 U
Thallium				1 U	1 U	1 U		1 U		1 U		1 U
Zinc				150	14	16		330		37		28

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	SP6-CD		SP7-2.5		SP7-C		SP8-2.5		SP8-C		SP9-2.5		SP9-5.0		SP9-C		SP10-4.0		SP10-C		SP11-C	
Inorganics																						
Cyanide, Total	0.68				0.44				0.32						2.5				4.7		0.29	
Fluoride	100				210				1000	>					1000				460		1000	>
Organics																						
Total PAHs	74		0.2	U	920		0.2	U	620		3900	>	0.2	U	1100		0.2	U	160		0.2	U
Acenaphthene	0.54																		1.9			
Acenaphthylene	0.0067	U																	0.33			
Anthracene	0.79																		3.9			
Benzo(a)anthracene	7.3																		18			
Benzo(a)pyrene	11																		21			
Benzo(b)fluoranthene	14																		32			
Benzo(g,h,i)perylene	8.5																		14			
Benzo(k)fluoranthene	6																		11			
Chrysene	9																		21			
Dibenzo(a,h)anthracene	2.3																		3.3			
Fluoranthene	9.1																		30			
Fluorene	0.26																		0.91			
Indeno(1,2,3-cd)pyrene	8.8																		14			
Naphthalene	0.048																		0.44			
Phenanthrene	3																		18			
Pyrene	8.4																		28			
PCBs																						
Total PCBs	0.2	U			0.2	U			0.2	U	0.2	U	0.2	U	0.39		0.2	U	0.92		0.2	U
Aroclor 1016																			0.05	U		
Aroclor 1221																			0.1	U		
Aroclor 1232																			0.05	U		
Aroclor 1242																			0.05	U		
Aroclor 1248																			0.77			
Aroclor 1254																			0.05	U		
Aroclor 1260																			1.7			
TPH																						
Diesel																						
Gasoline																						
Heavy/Bunker																						

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-6
South Landfill Analytical Results

Sample Id	SP6-CD		SP7-2.5		SP7-C		SP8-2.5		SP8-C		SP9-2.5		SP9-5.0		SP9-C		SP10-4.0		SP10-C		SP11-C	
Metals																						
Antimony	2.5	U			10				2.5	U					3.2				15		4.5	
Arsenic	1.2				5.7				13						10				15		3.9	
Beryllium	1	U			3.3				1	U					5				3.4		7	
Cadmium	1	U			1.7				1.1						1.7				3.2		4.5	
Chromium	10				54				11						54				100		40	
Copper	52				7900				80						5200				3400		2100	
Lead	10	U			82				30						60				520		56	
Mercury	0.25	U			0.25	U			0.25	U					0.25	U			0.25	U	0.82	
Nickel	12				59				130						160				200		84	
Selenium	1	U			1	U			1	U					1	U			1	U	1	U
Silver	1	U			1	U			1	U					1	U			1	U	1	U
Thallium	1	U			1	U			1	U					1	U			1	U	1	U
Zinc	31				130				39						99				380		850	

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

for TPH. Discrete samples from selected test pits were also analyzed to better characterize the material at depth.

An ER survey was conducted in September 1994 by Geo Recon International of Seattle, Washington, to further delineate the horizontal and vertical extent of the south landfill. Grids were initially established at 100-foot intervals across the area. The three northern grids were subsequently divided into 50-foot intervals. Soil resistivity measurements were collected along the grid lines at specific locations, and the data were recorded for analysis.

Field Observations

Observations made during test pit excavation and the ER survey suggest that the south landfill is fairly well defined. Remnant waste material was thickest in the north and center portions of the investigative area. Waste fill at SP1, C1.5, and D4 is about 6 to 7 feet deep. Waste fill depth decreases to between 2 and 4 feet at test pits SP2, E2, SP9, E5, SP10, and SP11. Waste fill was detected in the perimeter test pits (SP3, SP4, SP5, SP6, SP7, and SP8) at depths generally less than 1 foot.

Summary of Sampling Results

Test results indicate the presence of PAHs in many locations. Most PAH detections appear to be associated with a black, carbon-like material that is noted in more than half of the test pits. PAH concentrations were greater than 10,000 mg/kg in a composite sample from SP1. PAH concentrations greater than 1,000 mg/kg were measured in two locations (SP9 and C1.5-6). PAHs occurred at concentrations between 500 mg/kg and 1,000 mg/kg in another four test pits. Seven test pits contained PAHs at concentrations between 14 and 310 mg/kg. PAHs were nondetectable in only two test pits (SP3 and SP11).

Fluoride was detected throughout the south landfill. Fluoride at concentrations of 1,000 mg/kg or more was detected in SP2, SP8, SP9, and SP11 composite samples. Fluoride concentrations greater than 400 mg/kg were detected in six other locations.

PCBs were detected in concentrations up to 1.1 mg/kg in four test pits (SP9, SP10, E2, and E5). Discrete samples from test pits SP9 and SP10 were subsequently analyzed for total PCBs but none were detected.

Metal concentrations are as shown in Table 2-6. Lead was detected at 350 and 520 mg/kg in C1.5 and SP10, respectively. Copper was detected at 36,000 mg/kg in C1.5-C and at concentrations greater than 1,000 mg/kg in E5, SP2, SP4, SP7, SP9, SP10, and SP11. Arsenic was detected at concentrations between 1 and 18 mg/kg in 13 of the 16 test pits. Beryllium was detected at concentrations up to about 9 mg/kg, and nickel was found at concentrations up to 200 mg/kg.

East Potliner Area

The east potliner area was identified through aerial photographs by RMC and CH2M HILL staff as an area where waste may have been placed in the past. In July 1994, a black, blocky material resembling potliner was revealed in the road as a result of truck traffic in the area. Further inspection of aerial photographs showed that the area had been used as a temporary waste storage area in the past. Analytical results for samples collected in this area are summarized in Table 2-7.

Summary of Previous Sampling

No previous site investigation activities occurred in this location, and no samples were collected.

Work Performed

Eight test pits were excavated in the open areas that could be reached with a backhoe. After test pit excavation, a brush hog was mobilized to the site to remove the blackberry bushes and allow the area to be visually surveyed. CH2M HILL personnel then walked through and mapped the area looking particularly for spent potliner. The two additional waste areas to the north of the excavation area were identified and sampled.

Discrete soil samples were collected from the walls of each test pit. Test pits were excavated to 3 to 4 feet in most areas. There was no visually identifiable waste material more than a few inches bgs.

Discrete soil samples collected from each test pit were composited and analyzed for cyanide, fluoride, and total PAHs. In addition, a surface soil sample from the installation of monitoring well MW11 showed total PCB aroclors at 1.2 mg/kg. Subsequently, surface soil samples from each test pit location were analyzed for PCBs.

Field Observations

Test pit excavation revealed only surficial deposition of a gray material at various places within the area of concern. No other waste or fill material was found. Native soil in the test pits was predominantly sand. The material piles identified after site clearing visually resembled spent potliner.

Summary of Sampling Results

Cyanide was detected in six of the eight test pits at concentrations less than 2 mg/kg. PAHs were detected in only one of the eight test pits at a concentration of 2 mg/kg. Fluoride was detected in all test pits except EP1. Analyses were performed on discrete surface samples for PCBs. PCBs were detected in one surface soil sample (EP5-S) at 0.43 mg/kg.

Table 2-7
East Potliner Area Analytical Results

Sample Id	EP1-S		EP1-C		EP2-S		EP2-C		EP2-CD		EP3-S		EP3-C		EP4-S		EP4-C		EP5-S		EP5-C		EP6-S		EP6-C		EP7-S		EP7-C		EP8-S		EP8-C	
Inorganics																																				
Cyanide, Total			0.1	U			3.8		0.71				1.2				2				0.9				0.59				2				0.1	U
Fluoride			5	U			47		41				500	>			500	>			190				55				10				8.5	
Organics																																				
Total PAHs			0.2	U			0.2	U	0.2	U			0.2	U			0.2	U			2				0.2	U			0.2	U			0.2	U
Total PCBs	0.2	U			0.2	U					0.2	U			0.2	U			0.43				0.2	U			0.2	U			0.2	U		

Units = mg/kg
U = non detects
> = greater than
Blank spaces = not analyzed

Scrap Yard

The scrap yard was historically used for storage of obsolete equipment and scrap metal. Analytical results for soil samples collected in this area are provided in Table 2-8.

Summary of Previous Sampling

EPA contract personnel collected four surface soil samples from the scrap yard during the SIP investigation in 1993. The samples were collected outside the area where the mercury-contaminated soil was previously removed. PAHs, metals, cyanide, and fluoride were detected.

Work Performed

Fifteen test pits were excavated by CH2M HILL in July 1994. Test pits were located in places where stained soil, depressions, dark material, or other visual features might indicate the presence of possible contamination. Discrete soil samples were collected in each test pit at the surface, mid-depth, and in most cases, full depth. The discrete samples from each test pit were combined into composites and analyzed for cyanide, fluoride, PAHs, and PCBs. Selected discrete samples were analyzed for PAHs. Three samples were also tested for priority pollutant metals.

Field Observations

As discussed below, about half of the test pits contained brick near the surface. The maximum depth at which brick was found was about 2 feet bgs. Two of the test pits (SY6 and SY7) also encountered very hard digging at shallow depth. In these locations, the backhoe used for the excavations encountered refusal at depths of 2 feet and 1 foot, respectively. The material in these locations was well indurated or cemented sand.

Summary of Sampling Results

The maximum cyanide concentration detected in any soil sample was 11 mg/kg. The maximum fluoride concentrations were 1,800 and 1,400 mg/kg in SY8 and SY10, respectively.

Total PAHs were detected in 9 of the 15 test pits constructed (SY1, SY2, SY3, SY5, SY6, SY7, SY9, SY14, and SY15) at concentrations ranging from 4.5 to more than 2,800 mg/kg).

PAH concentrations were highest in the composite samples. PAHs were nondetectable in discrete samples from 2- and 4-foot depths collected at SY1, SY2, and SY14 (all locations where PAHs were detected in the overall test pit composite sample). These data suggest that PAHs may be more prevalent in surface soils.

PCBs were detected in 7 of the 15 test pit locations. With the exception of SY6, all PCB concentrations were less than 2 mg/kg. PCB concentrations at SY6 measured 16 mg/kg.

Table 2-8
Scrap Yard Analytical Results

Sample Id	SY1-2.0		SY1-4.0		SY1-C		SY2-2.0		SY2-4.0		SY2-C		SY3-C		SY4-C		SY5-C		SY6-S		SY7-S		SY8-C		SY9-C
Inorganics																									
Cyanide, Total					1.2						0.2		0.52		1.2		21		1		8.2		11		2.1
Fluoride					54						71		190		330		240		870		1100		1800		510
Organics																									
Total PAHs	0.2	U	0.2	U	110		0.2	U	0.2	U	28		13		0.2	U	9.6		250	>	2800	>	0.2	U	4.5
Acenaphthene					0.42																				
Acenaphthylene					0.067	U																			
Anthracene					0.74																				
Benzo(a)anthracene					5.3																				
Benzo(a)pyrene					6.1																				
Benzo(b)fluoranthene					9.3																				
Benzo(g,h,i)perylene					2.7																				
Benzo(k)fluoranthene					2.4																				
Chrysene					7.9																				
Dibenzo(a,h)anthracene					1.1																				
Fluoranthene					9																				
Fluorene					0.18																				
Indeno(1,2,3-cd)pyrene					3.4																				
Naphthalene					0.067	U																			
Phenanthrene					3.4																				
Pyrene					9.4																				
Total PCBs					0.2	U					0.2	U	0.97		1.3		0.86		16		1.6		0.2	U	0.78
Metals																									
Antimony													2.5	U			3.2						2.5	U	
Arsenic													4				6.2						6.7		
Beryllium													1	U			4.4						30		
Cadmium													29				2.4						1	U	
Chromium													63				82						8.1		
Copper													3300				7600						120		
Lead													63				82						17		
Mercury													0.41				0.55						0.32		
Nickel													41				70						30		
Selenium													1	U			1	U					1	U	
Silver													1	U			1	U					1	U	
Thallium													1	U			1	U					1	U	
Zinc													56				83						38		

Units = mg/Kg
U = non detects
> = greater than
Blank spaces = not analyzed

Table 2-8
Scrap Yard Analytical Results

Sample Id	SY10-C		SY11-C		SY12-C		SY13-C		SY14-2.0		SY14-4.0		SY14-C		SY15-C	
Inorganics																
Cyanide, Total	2.1		0.1	U	0.1	U	0.15						2.2		0.1	U
Fluoride	1400		46		24		5.8						70		5	U
Organics																
Total PAHs	0.2	U	0.2	U	0.2	U	7.5		0.2	U	0.2	U	140		0.2	U
Acenaphthene													0.15			
Acenaphthylene													0.0067	U		
Anthracene													0.2			
Benzo(a)anthracene													2			
Benzo(a)pyrene													2.7			
Benzo(b)fluoranthene													3.7			
Benzo(g,h,i)perylene													2.1			
Benzo(k)fluoranthene													1.2			
Chrysene													2.3			
Dibenzo(a,h)anthracene													0.52			
Fluoranthene													2.7			
Fluorene													0.076			
Indeno(1,2,3-cd)pyrene													2.1			
Naphthalene													0.023			
Phenanthrene													1.1			
Pyrene													2.6			
Total PCBs	0.44		0.2	U	0.2	U	0.2	U					0.2	U	0.2	U
Metals																
Antimony																
Arsenic																
Beryllium																
Cadmium																
Chromium																
Copper																
Lead																
Mercury																
Nickel																
Selenium																
Silver																
Thallium																
Zinc																

Units = mg/Kg
U = non detects
> = greater than
Blank spaces = not analyzed

Parking Lot

Field activities were completed in the parking lot area to investigate an allegation made to EPA that spent potliner may have been used as fill during construction. Analytical results for soil samples collected in this area are provided in Table 2-9.

Summary of Previous Sampling

No previous site investigation activities occurred in this location and no samples were collected.

Work Performed

Four test holes were advanced with a geoprobe in the locations shown. The geoprobes were driven to a maximum depth of 7 feet bgs and core samples were collected in the 1- to 3-, 3- to 5-, and 5- to 7-foot depth ranges. Each core sample was submitted for laboratory analysis of cyanide, PAHs, and PCBs.

Field Observations

The geoprobe sampling was performed in the dividers, between the paved areas of the east parking lot. The samples showed that the material in the probe holes consisted of sand and silty sand, either native material or fill material from a nearby source.

Summary of Sampling Results

Sample analyses revealed no detectable cyanide, PAHs, or PCBs. These data indicate that there is no evidence to suggest that spent potliner was used as fill in the parking lot.

Cryolite Ponds

The cryolite ponds (which are all dry) include one main surface impoundment, approximately 160 feet in diameter, and two smaller satellite ponds. Until about 1977, the ponds were used to store and recover spent cryolite (sodium aluminum fluoride [Na_2AlF_6]) from the aluminum reduction process. After 1977, the reduction process was changed so that cryolite recovery was no longer necessary. Analytical results for samples collected in this area are provided in Table 2-10.

Summary of Previous Sampling

EPA contract personnel collected two soil samples, one surface and one at 1 foot bgs, from the main pond area. Concentrations of sodium (5 to 11.5 percent), aluminum (20.7 to 32.2 percent), and fluoride (13.4 to 19.8 percent) were detected in both the surface and subsurface soil samples. Metals were also detected. PAHs were detected in surface soil (less than 0.1 mg/kg) and subsurface soil (less than 10 mg/kg).

Work Performed

Field work included subsurface investigation of the main pond (CP1 and CP2), two satellite ponds (CP3 and CP4), and an adjacent grassy area south of the main pond (CP5 and CP6) as shown in Figure 2-2. Soil samples were collected in the grassy area to investigate the lateral extent of possible cryolite distribution. Subsurface samples in the pond interiors were collected with a hand auger because of the difficulty in lifting a piece of equipment over the berms and into the ponds. Discrete samples were typically collected at each location from the surface, 2.5 to 3 feet bgs, and at 5 feet. A sample was also collected from CP2 at 10.5 feet bgs.

Composite samples from the main pond and the south grassy area were analyzed for cyanide, total PAHs, total PCBs, and priority pollutant metals. Composite samples CP5 and CP6 were also analyzed for fluoride. Discrete samples collected at depth from these locations were analyzed to evaluate the extent of constituents present.

Samples collected in the satellite ponds were analyzed as discretes to evaluate the extent of vertical constituent distribution. Fluoride, cyanide, total PAHs, total PCBs, and priority pollutant metals concentrations were analyzed in CP3 at 1.2 feet and CP4 at 2.5 feet. Surface soil samples from these locations were tested for fluoride, cyanide, total PAHs, and total PCBs only.

Field Observations

A cryolite-appearing material was detected in locations CP1 to CP4, as expected. The material was grayish in color and fairly easy to hand auger through. Samples CP5 and CP6 were surface samples collected in a grassy area south of the main cryolite ponds, and field logs indicate a predominance of sand in the subsurface.

Summary of Sampling Results

Cyanide was generally detected at levels up to 20 mg/kg. However, one surface sample, CP3-S, contained 100 mg/kg of cyanide. Fluoride was detected at concentrations ranging from 750 to 2,100 mg/kg in all samples collected from the main and satellite ponds (CP1 to CP4). Fluoride concentrations in the south grassy area were between 16 and 38 mg/kg.

PAHs were detected in all pond area samples. The highest concentrations of total PAHs (12 to 61 mg/kg) were detected in samples CP1 and CP2 from the main pond. Total PAH concentrations were less than 3.5 mg/kg in samples from the satellite ponds. No PAH detections were identified in the CP5 or CP6 samples south of the main pond.

No sample analyzed contained any concentration of PCBs above the detection limits.

Metals were detected at concentrations similar to those previously measured by EPA.

In summary, these data indicate that cryolite is present in the main cryolite pond area to a depth of at least 10.5 feet bgs (the maximum depth that subsurface material visually appeared to be cryolite). Cryolite does not appear to be present in the area south of the ponds as represented by CP5 and CP6.

South Wetlands

Soil samples were collected in the south wetlands area because process wastewater has, in the past, been discharged to this area. Samples were collected and analyzed to investigate the nature of constituents present. Analytical data for samples collected in this area are provided in Table 2-11.

Summary of Previous Sampling

No previous sampling was conducted by EPA in this area.

Work Performed

Five soil samples (SW1 to SW5) were collected with a hand auger in locations believed to be near the process wastewater discharge to the south wetlands. The area was dry at the time of sampling. The hand auger was advanced to a depth of about 3 feet in each location. Discrete soil samples were collected at the surface and 3 foot depths. Discrete samples from each location were composited and analyzed for cyanide, fluoride, total PAHs, total PCBs, priority pollutant metals, chlorinated pesticides, and TPH. Following receipt of total PCB test results, additional analysis of PCB aroclors was completed on a discrete surface and subsurface sample from SW1.

A sixth location (SW-6) was sampled after visual reconnaissance identified the presence of a gray looking material at the ground surface. A single discrete surface soil sample was collected with a hand auger at this location and analyzed for cyanide, fluoride, total PAHs, chlorinated pesticides, and TPH.

Field Observations

Soil samples collected at SW1 to SW5 were described in field logs as containing organic root matter and sand with no indication of waste materials or fill.

Summary of Sampling Results

Cyanide was detected in SW1, SW4, and SW5 composite samples and SW6 surface soil at concentrations between 0.17 and 2.9 mg/kg. Fluoride was detected in all samples at concentrations ranging from 450 to greater than 500 mg/kg. Total PAHs were detected in samples SW1 and SW6 at 14 and 19 mg/kg, respectively. A detection of 0.7 total PCBs was identified in sample SW1. Because of this, additional analyses were conducted on discrete samples collected at SW1 from the ground surface and 3 feet bgs. Aroclors 1242 and 1260

Table 2-11
South Wetlands Analytical Results

	Sample Id	SW1-S		SW1-3.0		SW1-C		SW2-C		SW3-C		SW4-C		SW5-C		SW-6-S	
Inorganics																	
	Fluoride					580		500	>	500	>	500	>	600		450	
	Cyanide, Total					0.51		0.1	U	0.1	U	2.9		0.17		0.36	
Organics																	
	Total PAHs					14		0.2	U	0.2	U	0.2	U	0.2	U	19	
Pesticides/PCBs																	
	Total PCBs					0.7		0.2	U	0.2	U	0.2	U	0.2	U		
	4,4'-DDD					0.05	U	0.08		0.03		0.073		0.005	U		
	4,4'-DDE					0.05	U	0.05		0.013		0.05	U	0.005	U		
	4,4'-DDT					0.05	U	0.28		0.005	U	0.05	U	0.005	U		
	Aldrin					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Alpha-BHC					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Beta-BHC					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Chlordane					1.5	U	0.75	U	0.15	U	1.5	U	0.15	U		
	Delta-BHC					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Dieldrin					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Endosulfan I					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Endosulfan II					0.05	U	0.025	U	0.0078		0.05	U	0.005	U		
	Endosulfan Sulfate					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Endrin					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Endrin Aldehyde					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Gamma-BHC					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Heptachlor					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Heptachlor Epoxide					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Methoxychlor					0.05	U	0.025	U	0.005	U	0.05	U	0.005	U		
	Toxaphene					1.5	U	0.75	U	0.15	U	3	U	0.7	U		
PCBs																	
	Aroclor 1016	1	UJ	0.05	UJ												
	Aroclor 1221	2	UJ	0.1	UJ												
	Aroclor 1232	1	UJ	0.05	UJ												
	Aroclor 1242	31	J	0.05	UJ												
	Aroclor 1248	1	UJ	0.05	UJ												
	Aroclor 1254	1	UJ	0.05	UJ												
	Aroclor 1260	14	J	0.05	UJ												
TPH																	
	Diesel					50	U	50	U	50	U	50	U				
	Gasoline					20	U	20	U	20	U	20	U				
	Heavy/Bunker					100	U	100	U	100	U	260					
Metals																	
	Antimony					2.5	U	2.5	U	2.5	U	2.5	U	2.5	U		
	Arsenic					9.1		14		8.6		13		5.9			
	Beryllium					2.5		2.6		3		2.3		1	U		
	Cadmium					1	U	1	U	1	U	1	U	1	U		
	Chromium					14		12		11		56		44			
	Copper					440		96		190		400		19			
	Lead					35		46		46		49		29			
	Mercury					0.33		0.25	U	0.25	U	0.68		0.25	U		
	Nickel					490		830		780		670		590			
	Selenium					1.5		1	U	1	U	1	U	1	U		
	Silver					1	U	1	U	1	U	1	U	1	U		
	Thallium					1	U	1	U	1	U	1	U	1	U		
	Zinc					47		56		64		70		47			

Units = mg/Kg
U = non detects
> = greater than
J = estimated value
Blank spaces = not analyzed

were detected in SW1-S at 31 mg/kg and 14 mg/kg, respectively. No aroclor detection was made in SW1-3, suggesting that the measured PCBs are located primarily near the ground surface. TPH (heavy oil bunker) at 260 mg/kg was also identified in sample SW4.

Metal concentrations for all samples are as shown in Table 2-11. Arsenic concentrations ranged between 5.9 and 14 mg/kg. Nickel was identified in concentrations ranging from 490 mg/kg at SW1 to 780 mg/kg in SW3.

Chlorinated pesticides were identified in samples from SW4, SW5, and SW6. Detections were noted for DDD, DDE, and DDT at SW4, DDD and DDE at SW5 and DDD only at SW6. Concentrations for all chlorinated pesticides ranged from 0.01 to 0.28 mg/kg.

Miscellaneous Areas

Seven miscellaneous areas of concern were identified through aerial photographs and site reconnaissance: west field, sparse vegetation area, outfall road, north dike, east field, Fairview Farms Field, and ditch south of BPA substation. Samples were collected at all areas of concern using the field methods established in the approved Quality Assurance Sampling Plan. Sample results are shown in Table 2-12 for all miscellaneous areas, which are described below:

- **West field area:** The west field was identified by the aerial photographs as an area where temporary storage of materials may have occurred. Three test pits were excavated to depths of 3 to 4 feet. The test pit locations are designated WF1, WF2, and WF3 in Figure 2-2. Samples were collected at depths of 1.5 to 2 feet and sent to the laboratory to be analyzed for fluoride and cyanide. All pits appeared to be free of bricks and debris. There was no evidence indicating that dumping or burying of material had occurred. No cyanide was detected in any test pit. Fluoride at concentrations of 36 and 38 mg/kg were detected in WF2 and WF3, respectively.

- **Sparse vegetation area:** E&E identified the sparse vegetation area as a location of concern because of the dried-out vegetation present. Two hand-auger borings were drilled to 3 feet bgs. The hand auger locations are designated SA1 and SA2 in Figure 2-2. Samples were collected at the surface and at 3 feet, then composited and analyzed for cyanide, fluoride, PAHs, PCBs, and chlorinated pesticides. Soils appeared to be poorly graded sand that was free of brick and debris. Cyanide, fluoride, total PAHs, total PCBs, and pesticides were nondetectable in SA1. Fluoride, at a concentration of >500 mg/kg, was found in SA2 along with total PAHs at 0.25 mg/kg. Metals concentrations were measured as shown.

- **Outfall road:** The outfall road was identified during the site reconnaissance because of the brick and other debris that are present throughout the road. A surface sample was collected in the area and sent to be analyzed for cyanide

Table 2-12

Miscellaneous Area Analytical Results

	West Field Area						Sparse Vegetation Area				Outfall Road		North Dike				East Field				Fairview Farm Field				Ditch South of BPA Sub-station	
Sample Id	WF1-2.0		WF2-2.0		WF3-2.0		SP5-SA1-C		SP5-SA2-C		OR-1-S		ND-1-S		ND-2-S		SPWP-A		SPWP-B		RM-S15		RM-S16		RM-S17	
Inorganics																										
Cyanide, Total	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	2		0.1	U	0.1	U	0.85		1.2		4.9		0.52		0.1	U
Fluoride	8.4	U	36		38		5	U	500	>							920		1500		30		11		5	U
TOC																					30000		24000		3300	
Organics																										
Total PAHs							0.2	U	0.25		500	>	0.2	U	4.2		19		0.2	U						
Acenaphthene																	0.11		0.028		0.11		0.16		0.0067	U
Acenaphthylene																	0.069		0.0076		0.034	U	0.047	U	0.0067	U
Anthracene																	0.29		0.031		0.17		0.26		0.0067	U
Benzo(a)anthracene																	1.2		0.13		1.8		2.4		0.054	
Benzo(a)pyrene																	0.92		0.052		2.1		2.9		0.082	
Benzo(b)fluoranthene																	1.3		0.19		3.9		5.3		0.16	
Benzo(g,h,i)perylene																	0.57		0.022		1.3		1.8		0.052	
Benzo(k)fluoranthene																	0.44		0.036		0.75		1.2		0.036	
Chrysene																	1.1		0.14		1.7		2.2		0.051	
Dibenzo(a,h)anthracene																	0.19		0.0084		0.36		0.52		0.014	
Fluoranthene																	2.6		0.3		1.8		2.5		0.06	
Fluorene																	0.14		0.014		0.034	U	0.062		0.0067	U
Indeno(1,2,3-cd)pyrene																	0.56		0.017		1.1		1.5		0.049	
Naphthalene																	0.17		0.2		0.034	U	0.047	U	0.0067	U
Phenanthrene																	2		0.29		0.71		1		0.023	
Pyrene																	2.2		0.24		1.8		2.5		0.061	
PCBs																										
Total PCBs							0.2	U	0.2	U							0.2	U	0.2	U						
Aroclor 1016																	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1221																	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1232																	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1242																	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1248																	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1254																	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1260																	0.16		0.18		0.12		0.17		0.05	U
Pesticides																										
4,4'-DDD							0.005	U	0.005	U																
4,4'-DDE							0.005	U	0.005	U																
4,4'-DDT							0.005	U	0.005	U																
Aldrin							0.005	U	0.005	U																
Alpha-BHC							0.005	U	0.005	U																
Beta-BHC							0.005	U	0.005	U																
Chlordane							0.15	U	0.15	U																
Delta-BHC							0.005	U	0.005	U																
Dieldrin							0.005	U	0.005	U																
Endosulfan I							0.005	U	0.005	U																
Endosulfan II							0.005	U	0.005	U																
Endosulfan Sulfate							0.005	U	0.005	U																
Endrin							0.005	U	0.005	U																
Endrin Aldehyde							0.005	U	0.005	U																
Gamma-BHC							0.005	U	0.005	U																
Heptachlor							0.005	U	0.005	U																
Heptachlor Epoxide							0.005	U	0.005	U																
Methoxychlor							0.005	U	0.005	U																
Toxaphene							0.15	U	0.3	U																

Units = mg/Kg

U = non detects

> = greater than

Blank space = not analyzed

Table 2-12
Miscellaneous Area Analytical Results

Sample Id	West Field Area			Sparse Vegetation Area		Outfall Road	North Dike		East Field		Fairview Farm Field		Ditch South of BPA Sub-station
	WF1-2.0	WF2-2.0	WF3-2.0	SP5-SA1-C	SP5-SA2-C	OR-1-S	ND-1-S	ND-2-S	SPWP-A	SPWP-B	RM-S15	RM-S16	RM-S17
TPH													
TPH											64	160	20 U
Gasoline											2 U	4 U	2 U
Diesel/related											33.	36	25 U
Metals													
Aluminum									64000	40000	15000	13000	14000
Antimony				2.5 U	2.5 U				4.6	13	2.5 U	2.5 U	2.5 U
Arsenic				1 U	5.7				19	28	3.9	4.3	1.3
Barium									54	54	110	120	48
Beryllium				1 U	1 U				6.7	5.8	1 U	1 U	1 U
Cadmium				1 U	1 U				2.5	1.8	1 U	1 U	1 U
Calcium									10000	11000	5600	4400	5400
Chromium				6.1	10				69	150	18	20	8.7
Cobalt									24	32	10	9.1	8.2
Copper				7.8	15				8100	5500	30	30	30
Iron									100000	190000	19000	13000	17000
Lead				10 U	10 U				32	28	19	20	10 U
Magnesium									330	250	3600	3000	1200
Manganese									1400	1600	220	110	130
Mercury				0.25 U	0.25 U				0.25 U	0.25 U	0.2 U	0.2 U	0.2 U
Nickel				5.8	72				170	160	28	25	9.6
Potassium									250	320	3000	1100	320
Selenium				1 U	1 U				1 U	1 U	1 U	1 U	1 U
Silver				1 U	1 U				1 U	1 U	1 U	1 U	1 U
Sodium									32000	32000	640	380	1300
Thallium				1 U	1 U				1 U	1 U	1 U	1 U	1 U
Vanadium									100	180	57	63	49
Zinc				17	28				28	24	80	63	32

Units = mg/Kg
U = non detects
> = greater than
Blank space = not analyzed

and PAHs. The sample location is designated OR-1 in Figure 2-1 and was found to contain cyanide at 2 mg/kg and fluoride at >500 mg/kg.

- **North dike:** Some of the fill material in the north dike was noted during the site reconnaissance. Surface samples were collected and sent to be analyzed for cyanide and PAHs. The sample locations are designated ND-1 and ND-2 in Figure 2-1. Only PAHs, at 4.2 mg/kg, were detected in ND-2.

- **East field:** Two samples were collected (SPWP-A and SPWP-B) in this location near the east potliner area. Each sample was analyzed for total cyanide, fluoride, total PAHs, PAH species, total PCBs, PCB aroclors, and metals. Cyanide was detected at a peak concentration of 1.2 mg/kg. Fluoride concentrations ranged between 920 mg/kg and 1,500 mg/kg. Total PAHs were measured at a peak concentration of 19 mg/kg. PAHs as a sum of constituents in this same sample measured only 13.9 mg/kg. PCB aroclor 1260 was detected at 0.16 and 0.18 mg/kg, respectively. Metals were detected as shown in Table 2-12.

- **Fairview Farms field:** Two surface soil samples (RM-S15 and RM-S16) were collected in this location west of the plant site. Cyanide was detected at 4.9 and 0.52 mg/kg, respectively. Fluoride was detected in both samples at 30 mg/kg or less. PAHs were identified in both samples with a peak detection of benzo(a)pyrene in RM-S16 at 5.3 mg/kg. Total PAHs (determined as a sum of constituents present) ranged between about 18 and 24 mg/kg. PCB aroclor 1260 was detected at 0.12 and 0.17 mg/kg. TPH as total and diesel was also detected at concentrations between 64 and 160 mg/kg and 33 and 36 mg/kg, respectively. Metal constituents were detected as shown in Table 2-12.

- **Ditch south of BPA substation:** One surface soil sample was collected in this location (RM-S17). No cyanide, fluoride, PCBs, or TPH constituents were detected. PAH species were detected at concentrations less than a peak of 0.16 mg/kg for benzo(b)fluoranthene. Metal constituents were as shown in Table 2-12.

Capacitor Search

The capacitor search was conducted in response to anonymous allegations made to EPA that capacitors were buried on the RMC property (see Section 1–Site Inspection History). Exact locations were not identified, but the general area reported was north of the U.S. Army Corps of Engineers (COE) dike, in the north landfill area, or in the brick fill area adjacent to the north dike.

In addition, two other potential waste areas were identified through site reconnaissance activities: under the BPA power lines (identified as "Powerline Area" in Figure 2-1) and the field west of the BPA substation. Other potential disposal areas were noted through interviewing a retired RMC employee. These areas were 50 feet south of the north landfill and 50 feet east of the carbon unloading dock.

Geophysics were used in an attempt to locate the electrical capacitors in the identified areas. An EDA OMN IV Magnetic Gradiometer was used to make geophysical readings over the areas above. The Magnetic Gradiometer measures the magnetic flux at its location, relative to the base station reading. The total field reading of the top sensor has been reduced to an arbitrary base station reading of 57,000 nano-Tesla (nT), using tieline methods to correct for diurnal variations occurring during the measurement periods. A separate base station was established for each of the five areas. The average magnetic field for the area was on the order of 57,000 nT.

Five sites were surveyed with the magnetic gradiometer on lines arbitrarily established across each area after discussions with CH2M HILL personnel. The five sites surveyed included the north landfill, an area approximately 50 feet south of the north landfill, the north dike, the powerline area, and the field west of the BPA substation. The area east of the carbon unloading dock was not surveyed because no potential waste sites could visually be identified in this area.

The results of the geophysical survey indicated a high magnetic field at a location in the eastern end of the north landfill, and in the field west of the BPA substation, which is owned by BPA. No magnetic anomalies were noted in the wooded area south of the north landfill. The north dike had high magnetic flux values that are likely the product of the significant deposits of refractory brick. The mound under the power lines also produced a high reading, possibly because of magnetic flux from the overhead power lines and from the refractory brick that was subsequently found buried there.

On the basis of the magnetic gradiometer surveys, three additional test pits were excavated: one in the north landfill (NE-CAP-SEARCH) and two on the mound in the powerline area (UTL-N and UTL-S). No capacitors were detected in these test pits. No test pits were excavated on the BPA property.

An electrical resistivity (ER) survey was also performed in the south landfill. The purpose of the ER survey was to further delineate the depth and extent of waste material in that area. Areas where significant resistivity anomalies were found were investigated further by digging test pits. No capacitors were found in these test pits.

Summary

The Phase 1 soil and debris investigation at Reynolds Metals Company has consisted of the following components:

- Seventeen test pits were excavated in the north landfill area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis. One additional test pit was excavated to investigate the alleged disposal of capacitors in the landfill.

- Sixteen test pits were excavated in the south landfill. The test pits were logged, and samples were collected and shipped to a laboratory for analysis.

- Eight test pits were excavated in the east potliner area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis. Two debris areas were also sampled and laboratory analyses were performed.

- Fifteen test pits were excavated in the scrap yard area. The test pits were logged, and samples were collected and shipped to a laboratory for analysis.

- Four geoprobe holes were pushed in the east parking lot area. The geoprobe holes were logged, and samples were collected and shipped to a laboratory for analysis.

- Six hand auger holes were advanced in the cryolite ponds area. The hand auger holes were completed, and samples were collected and shipped to a laboratory for analysis.

- Six hand auger holes were advanced in the south wetlands area. The hand auger holes were completed, and samples were collected and shipped to a laboratory for analysis.

- Miscellaneous areas were identified during the site and aerial photograph reconnaissance as possible debris areas. These areas included the west field area, the sparse vegetation area at Fairview Farms, the outfall road, and the north dike. Samples were collected in all of these areas and shipped to a laboratory for analysis.

- A search was made for capacitors that were allegedly buried on the RMC site. A geophysical survey was performed, using a magnetic gradiometer, to search for the buried capacitors. On the basis of the magnetometer survey results, test pits were excavated in the north landfill and under the BPA power lines in an attempt to locate any buried capacitors.

- A geophysical (electrical resistivity [ER]) survey of the south landfill was performed. The purpose of the ER survey was to help map the depth and extent of waste material in the south landfill. On the basis of the survey, five test pits were excavated and sampled.

Analytical Results

In general, all of the areas sampled had laboratory analyses performed for the following constituents:

- Soluble fluoride and total cyanide (Fl^- and CN^-, respectively)
- Total PCBs (PCB aroclors were analyzed for 10 percent of all samples)
- Total PAHs (PAH species were analyzed for 10 percent of all samples)
- EPA priority pollutant metals (13 metals: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc)

In addition, some areas had additional and/or different analyses performed on the basis of either the results of previous EPA investigations or what was detected in the field. These analyses included the following:

- Solvents
- Toxicity characteristic leaching procedure (TCLP) metals
- EPA 7000 Series metals (23 metals)
- Chlorinated pesticides
- Total petroleum hydrocarbons (TPH), the TPH diesel fraction (TPH-D), and the TPH gasoline fraction (TPH-G)
- Total organic carbon (TOC)

There are currently no generally accepted health or ecologically-based standards, criteria, or guidelines for comparison of the concentrations of substances in soil at the Troutdale plant. Therefore, no comparison is made for soil analytical results. Substances detected (excluding metals) and maximum concentrations for each area are as follows. Unless otherwise indicated, data results are for composite sample analyses.

- **North landfill.** PAHs, PCBs, TPH, cyanide, and fluoride were detected. The maximum concentrations detected in the east area were as follows: CN^-, 1.1 mg/kg; PAHs, 2,350 mg/kg (as sum of detected compounds); PCBs, 31 mg/kg; and TPH, 120 mg/kg. Maximum concentrations of constituents encountered in the west area were as follows: CN^-, 1.6 mg/kg; Fl^-, 490 mg/kg; PAHs, >1,400 mg/kg; and PCBs, 28 mg/kg (discrete subsurface soil at 5 feet bgs).

- **South landfill.** PAHs and PCBs, as well as cyanide and fluoride, were detected. The maximum concentrations detected were as follows: total PAHs, >10,000 mg/kg (one sample); PCBs (as sum of aroclors), 2.5 mg/kg; CN^-, 44 mg/kg; and Fl^-, >1,000 mg/kg.

- **East potliner area.** PAHs, PCBs, cyanide, and fluoride were detected. The maximum concentrations detected were as follows: total PAHs, 2 mg/kg; PCBs, 0.43 mg/kg (discrete surface soil); CN^-, 3.8 mg/kg; and Fl^-, >500 mg/kg.

- **Scrap yard.** PAHs, PCBs, cyanide, and fluoride were detected. The maximum concentrations detected were as follows: PAHs >2,800 mg/kg (discrete surface soil); PCBs, 16 mg/kg (discrete surface soil); CN^-, 21 mg/kg; and Fl^-, 1,800 mg/kg.

- **Parking lot.** No PAHs, PCBs, or CN^- were detected in samples. The samples were not tested for fluoride.

- **Cryolite ponds area.** PAHs, cyanide, and fluoride were detected. PCBs were not detected. The maximum concentrations detected were as follows: PAHs, 61 mg/kg; CN^-, 100 mg/kg (discrete surface soil); and Fl^-, 2,100 mg/kg.

- **South wetlands area.** PAHs and PCBs, as well as cyanide, fluoride, and chlorinated pesticides, were detected. The maximum concentrations detected were as follows: CN^-, 2.9 mg/kg; Fl^-, >500 mg/kg (three samples); PAHs, 19 mg/kg (discrete surface soil); PCBs (discrete surface soil), 45 mg/kg; DDD, 0.8 mg/kg; DDE, 0.05 mg/kg; and DDT, 0.28 mg/kg.

Data collected from the miscellaneous areas sampled are included in the text for those areas.

Section 3
Groundwater

Monitoring Well Installation Summary

CH2M HILL installed twelve shallow monitoring wells (from 18 to 32 feet deep) at the RMC facility in two phases. The monitoring wells were installed to assess shallow groundwater quality and flow directions at the site. In Phase 1, the first eight wells (MW01 through MW08) were installed between July 7 and July 12, 1994. These wells were subsequently developed, surveyed, and sampled, and water level elevations were measured. Resulting data were used to assess the need for additional monitoring wells at the facility. On the basis of this evaluation, four additional monitoring wells (MW09 through MW12) were installed on August 4 and 5, 1994 (Phase 2). Well installation was conducted with frequent oversight by E&E, EPA's contractor. Both EPA and RMC agreed on the objectives and procedures.

Monitoring well locations are shown in Figure 3-1. Also included in this figure is the location of a shallow BPA monitoring well (BPAT-05) located at the Troutdale Substation, which was sampled as part of the second sampling event. Well construction details are summarized in Table 3-1.

Methods

Drilling

Geo-Tech Explorations of Portland, Oregon, drilled the monitoring well boreholes with a Canterra CT-250 hollow-stem auger drilling rig. Borings were advanced with either 8.25-inch (10-inch-outside-diameter for 4-inch cased wells) or 6.25-inch (8-inch-outside-diameter for 2-inch cased wells) auger flights. Before drilling began at each location, the following tasks were completed:

- The drilling subcontractor filed a start card with the Oregon Water Resources Department (OWRD).
- Locations were cleared for subsurface and overhead utilities and marked.
- Downhole drilling and sampling equipment was steam cleaned before use at each location.
- Field monitoring equipment was tested and calibrated.
- Health and safety preparations were made in accordance with the site Health and Safety Plan.

Table 3-1 **Monitoring Well Construction Summary**
Reynolds Metals Company: Troutdale Oregon

Well ID	Installation Date	Depth (a)	Casing Diameter(b)	Borehole Diameter	Screened Interval (c)	Top of Filter Pack (a)	MPE (d)	GSE (e)	Screened Material
MW01	7/12/94	20	4-inch	12-inch	9 to 19	7	28.25	25.2	Sand (SP) Silt (ML)
MW02	7/11/94	24	4-inch	12-inch	13 to 23	12	31.65	28.6	Sand(SP,SM) Silt (ML)
MW03	7/9/94	18	2-inch	10-inch	9 to 17	7	29.69	27.4	Sand(SP,SM)
MW04	7/12/94	20	2-inch	10-inch	14 to 19	7	26.91	24.3	Silt (ML) Clay (CL)
MW05	7/8/94	25	2-inch	10-inch	13 to 23	12	33.99	31.6	Silt (ML) Sand (SM)
MW06	7/8/94	25	2-inch	10-inch	13 to 23	11	26.81	24.1	Silt (ML) Sand(SP,SM)
MW07	7/9/94	25	4-inch	12-inch	14 to 24	12	28.38	28.7	Sand (SM) Silt (ML)
MW08	7/7/94	28	2-inch	10-inch	17 to 27	14	25.32	22.8	Sand (SP)
MW09	8/4/94	32	2-inch	10-inch	20 to 30	18	29.27	27.0	Sand (SP)
MW10	8/5/94	25	4-inch	12-inch	8 to 23	7	30.28	27.9	Silt (ML)
MW11	8/5/94	19	2-inch	10-inch	7 to 17	6	31.61	29.5	Sand/Silt (SP/ML)
MW12	8/4/94	23	2-inch	10-inch	16 to 21	14	22.53	20.2	Sand (SP) Silt (ML)

(a) In feet below ground surface
(b) All Casing and screen constructed with flush-threaded Schedule 40 PVC
(c) In feet below ground surface
(d) MPE = measuring point elevation, feet, NGVD 1929.
(e) GSE = ground surface elevation, feet, NGVD 1929.

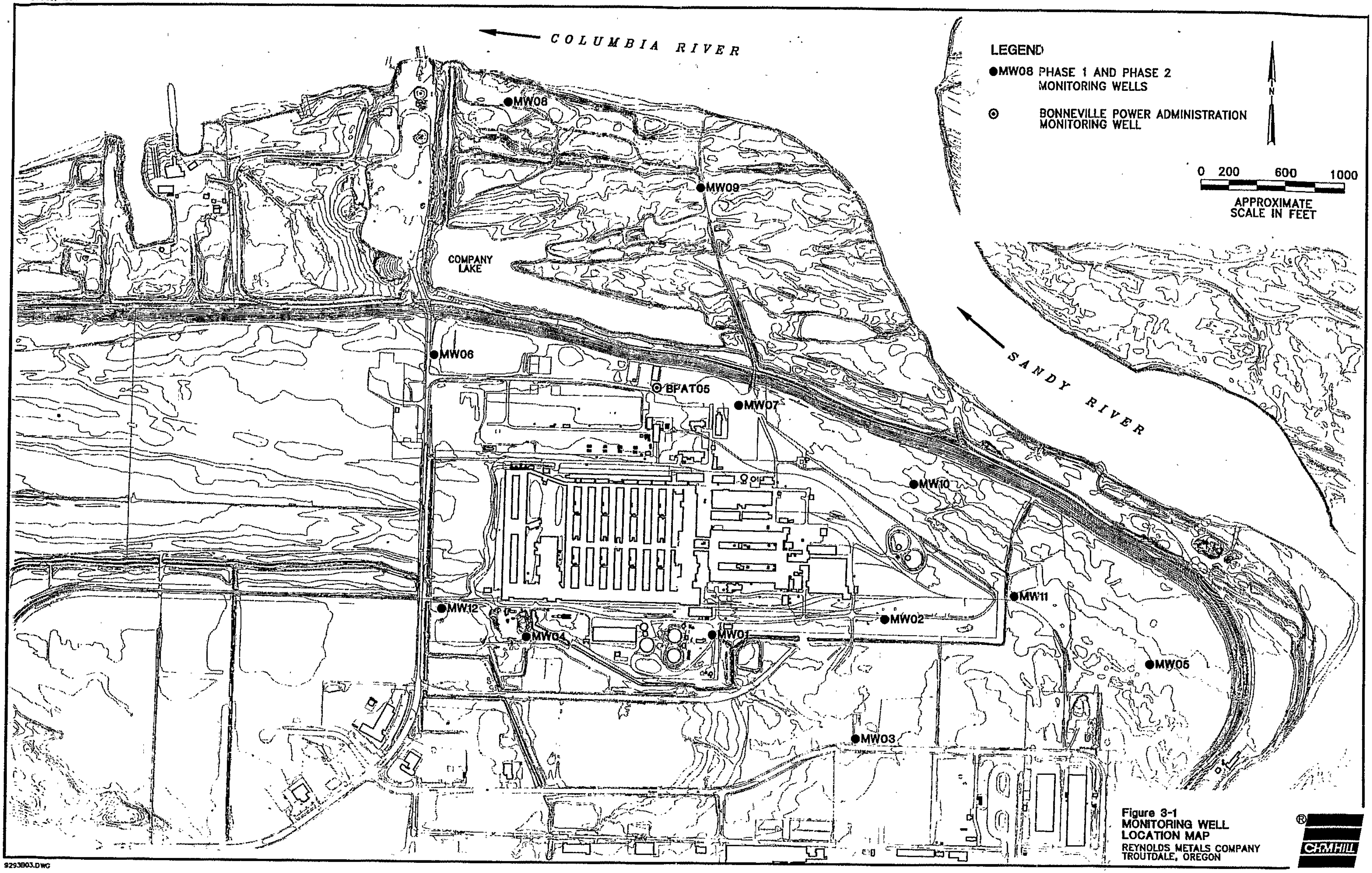

Figure 3-1
MONITORING WELL LOCATION MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

Boreholes were advanced to between 18 and 32 feet bgs. The field hydrogeologist determined well depths on the basis of field conditions and lithology encountered. Drill cuttings were collected and segregated into 55-gallon U.S. Department of Transportation (DOT) approved, sealed, and labeled drums.

Borehole Soil Sampling

Borehole soil samples were collected at 2.5-foot intervals from the surface until saturated conditions were encountered. Below the water table surface, soil samples were collected at 5-foot intervals to the base of the borehole. At some locations soil samples were collected at 2.5-foot intervals below the water table, depending on field conditions and soil types encountered.

Borehole soil samples were collected with an 18-inch-long, 3-inch-diameter, stainless steel, split-spoon sampler. A slide hammer was used to drive the sampler into the formation ahead of the drilling. The number of blows required to drive the sampler each 6-inch interval was recorded on the monitoring well geologic and construction logs included in Appendix D.

A CH2M HILL hydrogeologist geologically logged material from each sample in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure, ASTM D 2487-85). Geologic descriptions are also recorded on the monitoring well geologic and construction logs included in Appendix D.

After logging, soil from selected sample depths was collected from the split spoon and delivered to an environmental laboratory for analysis. In general, soil samples from the surface, from a midpoint between the surface and the water table surface, and from near the water table surface were submitted for laboratory screening and analysis. The number of samples analyzed and their locations, depths, and requested analyses are described under Borehole Samples, later in this section.

Monitoring Well Construction

After drilling, logging, and soil sampling were completed, a monitoring well was installed in each borehole (except at MW11, as described below). Well design varied in the field based on the results of geologic logging and water level information. Monitoring wells were installed in accordance with OAR 690-240 under the supervision of a licensed and bonded monitoring well contractor.

Wells MW01, MW02, and MW10 were constructed as 4-inch-diameter wells at the specific direction of the EPA contractor (E&E). On the basis of a preliminary assessment of groundwater flow direction and potential source areas, EPA felt that it may have been possible to use these wells as groundwater extraction wells if groundwater quality data had indicated that groundwater extraction was necessary. The remaining wells were installed with 2-inch-diameter casing.

Wells were completed with Schedule 40, flush-threaded polyvinyl chloride (PVC) well casing and screen with a 1-foot sump placed below the screened interval. Two stainless steel centralizers were attached to the casing above and below the screened interval to center the casing in the borehole during filter pack placement. A screened interval slot size of 0.01 inch, surrounded with Colorado Silica 20×40 sand as a filter pack, was used at each location.

The filter pack was poured into the annulus from the base of the borehole to no more than 2 feet above the top of the screened interval. The sand level was monitored frequently as the auger flights were withdrawn to detect any bridging. Before placement of the well seal, the well screen was surged for several minutes to settle the filter pack, and additional sand was placed to restore the filter pack to the design level.

Volclay bentonite chips were placed from the top of the filter pack to within 2 feet of the surface at each location. The pellets were hydrated for a minimum of 20 minutes before completion of each well. All wells, except MW07, were completed as abovegrade wells with protective steel casing fitted with locking caps surrounded by three concrete-filled steel bullards. MW07 was completed as a surface-mounted well with a watertight Sherwood monitoring well cover and a locking pressure cap for the PVC casing.

At MW11, the first borehole drilled was abandoned after the soil sampling and logging were complete because of the presence of heaving sand inside the auger flight. Because of difficulty in removing the sand from the augers, it did not appear that a filter pack could have been properly installed at this location. Therefore, the borehole was abandoned by backfilling with Volclay 3/4-inch bentonite chips from the base of the borehole to the surface as the auger flights were withdrawn, in accordance with OAR 690-240.

A second borehole was drilled approximately 10 feet to the east of the abandoned borehole. No soil samples were collected at this location to minimize disturbance to the formation and the intrusion of sands into the auger flight. MW11 was designed and installed in the second borehole on the basis of the observed geology and water level information gathered in the first borehole.

Monitoring Well Development

Well development began no sooner than 24 hours after the completion of each well. Wells were developed by preliminary surging and bailing to remove the most silt-laden waters, then by surging and pumping until (in the judgment of the field team) turbidity ceased to decrease. Reasonably clear water was obtained at all locations except MW04, MW10, and MW11. These wells recovered so slowly after bailing that an impracticable amount of time was required (approximately 1 week for full recovery) to effectively surge and bail/pump the well. These wells were surged and bailed/pumped a minimum of three times each, but the water remained turbid at these locations.

Monitoring Well Sampling

Groundwater samples were collected from the Phase 1 well installations (MW01 through MW08) on July 19, 1994. Groundwater samples were collected from Phase 2 of monitoring wells (MW09 through MW12), selected Phase 1 wells, and a shallow BPA monitoring well (BPAT-05) on August 15 and 16, 1994. Duplicate samples and equipment blanks were collected at a frequency of 10 percent as a quality control measure. Trip blanks were used in the second sampling event when VOCs became part of the analytical program. The analytical program is detailed under Groundwater Analytical Results, later in this section.

Water levels were measured with an electric water level indicator to within 0.01 foot to document static water level conditions and to allow for calculation of wellbore volumes. Before sampling, wells were purged of a minimum of three wellbore volumes using a 2-inch submersible Grundfos pump. Purging continued until field parameters (temperature, pH, and electrical conductivity) had stabilized to within 10 percent on two consecutive readings. The exception to this procedure occurred at monitoring wells MW04, MW10, and MW11, where purging three wellbore volumes was determined to be impracticable because of the low recovery rates. At these locations, the wells were bailed until no additional water could be removed, and then allowed to recover until enough water had entered the borehole that a sample could be collected. Purge water was collected in 55-gallon drums for later disposal.

Sampling hoses were dedicated at each well, so only the submersible Grundfos pump was decontaminated before use at each location. Disposable polyethylene bailers suspended on nylon monofilament fishing line were used at MW04, MW10, and MW11.

After the appropriate sample containers were filled, they were labeled with the sample identification number, sample collection date, project identifier, and the analytical method to be performed. At the end of each day, the sample containers were packed in ice, placed in a cooler with a copy of the completed chain-of-custody form, and sealed with custody tape. Samples were delivered to North Creek Analytical Laboratories in Beaverton, Oregon, via courier each day.

Production Well Sampling

Groundwater samples were collected from five RMC onsite production wells (PW03, PW07, PW08, PW10, and PW18) on August 16, 1994. Wellbore volumes and pumping rates were estimated, and the existing vertical line-shaft turbine pumps were used to purge each well a minimum of three (estimated) wellbore volumes, or until field parameters (temperature, pH, and electrical conductivity) had stabilized to within 10 percent on two consecutive measurements. Samples were collected from ports located at each wellhead.

Sample containers were prepared, packed, and shipped as described in the previous subsection, Monitoring Well Sampling. The analytical program for the production wells is described under Deeper Groundwater, later in this section. The drillers' logs for the sampled production wells are included in Appendix E.

Offsite Well Sampling

Three samples were collected from offsite locations west and northwest of the RMC facility on August 25, 1994. Water level measurements from the onsite shallow groundwater monitoring wells indicate that these locations are downgradient of the RMC facility. The samples were collected from the Fairview Farms well, the Sundial Marine well, and an unused domestic well owned by Gresham Sand and Gravel. The well locations are described under Offsite Groundwater, later in this section.

The borehole volume and pumping rates were estimated at each location and the wells were pumped for a minimum of three estimated wellbore volumes, or until field parameters had stabilized to within 10 percent on two consecutive measurements. Samples were collected from either existing plumbing and spigots or from open pipe discharge.

Sample containers were prepared, packed, and shipped as described under Monitoring Well Sampling, earlier in this section. The analytical program for the production wells is described under Shallow Groundwater, later in this section. The drillers' logs for the sampled production wells are included in Appendix E.

Bakehouse Sump and Wellpoint Sampling

Water samples were collected from four of the dewatering sumps and one of the wellpoints in and around the bakehouse on August 25, 1994. Because construction details, actual depths, and pumping schedules are unknown, the sumps were not purged of any significant volume before sample collection.

Bakehouse water samples were collected using a peristaltic pump. Tubing was discarded after use at each location. Sample containers were prepared, packed, and shipped as described earlier in the Monitoring Well Sampling section. The analytical program for the bakehouse samples is described later, in the Shallow Groundwater section. Because this effort was intended to be a preliminary assessment of water quality in the sumps, no trip blanks, duplicates, or other quality assurance samples were collected or prepared.

Water Level Measurements

Water levels were measured manually with an electronic water level sounder at the following locations:

- Monitoring wells MW01 through MW12
- Production wells PW06 and PW18
- Bakehouse sumps 7 and 11, and 16 through 21

- Accessible identified bakehouse wellpoints
- The Columbia River stilling well

Manual water levels were measured until two consecutive measurements agreed to within 0.01 foot. In addition to the manual water level measurements, five GEOKON data loggers and vibrating wire pressure transducers collected hourly water level measurements at selected locations. Data loggers are currently measuring water levels at the Columbia River, MW01, MW02, MW06, and PW06 (October 1994).

Physical Characteristics of the Study Area

Surface Features

The site physiography is apparent in the monitoring well location map shown in Figure 3-1. The site lies on a gently sloping floodplain at the confluence of the Sandy and Columbia Rivers. The northern site boundary is formed by the Columbia River, and the eastern site boundary is formed by the Sandy River. Following the general outline of the river banks is a COE flood control dike extending approximately 25 feet above grade. Access to the areas north and east of the dike is available via dirt roads that cross the dike near the east and west ends of Company Lake.

The southern site boundary is formed by Graham Road, which lies north of the Troutdale Airport. The western site boundary is formed by Sundial Road. Reynolds Metals Company also owns property south of the dike and west of Sundial Road.

Surface Water Hydrology

The primary surface water features at the site include the following:

- The Columbia River flowing east to west across the northern site boundary
- The Sandy River flowing southeast to northwest along the eastern site boundary
- Company Lake, lying north of the flood control dike near the northwestern site boundary
- East Lake, formerly connected to Company Lake to the west and the Sandy River to the east
- Salmon Creek, a formerly natural waterway, now dredged and controlled; it flows westward from the western property boundary
- Onsite drainage and stormwater ditch system

Company Lake and East Lake are apparently naturally occurring (were present before facility construction) surface water features. It is possible that the linear southeast-northwest depression that contains these features could be the result of an old cutoff channel of the Sandy River. Historical aerial photographs (1930s) show that Company Lake, East Lake, and the Sandy River were once connected. Aerial photographs also show that a drainage channel had been cut from the northwest corner of Company Lake to the Columbia River by 1952, causing the lake to decrease in size until it separated from East Lake. By 1966, East Lake had decreased in size until it became separated from the Sandy River.

Aerial photographs taken in 1968 indicate startup of a sand and gravel operation on the north side of the west end of Company Lake. By 1971, the west end of the lake had been filled with dredge spoils and a new ditch drainage was cut north to the Columbia River. By 1990, the road that had formerly detoured around the west end of the lake was straightened; it now forms the western border of the lake.

Process wastewater from the pot-room fluoride control system was discharged into Company Lake beginning in 1947. After the cryolite recovery plant was completed in 1957, collected stormwater, treated sanitary sewer effluent, and process and cooling water were collected and pumped to Company Lake. A regulated weir currently exists at the outfall to the Columbia River. The discharge from Company Lake to the Columbia River is regulated under an existing NPDES permit.

In 1963, additional drainage channels were cut into the south wetlands area to enhance drainage into Salmon Creek, and surface water in that area gradually disappeared. Salmon Creek currently flows east to west, draining the south wetlands area and receiving water from offsite drainage ditches originating near the Troutdale Airport.

In general, onsite drainage ditches collect surface water runoff from the area north and east of the plant, stormwater collected from the interior of the facility, groundwater pumped from the dewatering system near the bakehouse, water discharged from the onsite sewage treatment system, and the discharge from the ESP wastewater treatment system. This water is collected at a pumping station near the southwestern corner of the plant and pumped north through an underground pipeline into Company Lake.

Hydrogeology

Surface Geology

Soil types encountered during borehole drilling indicate that the surface sediments consist of a complex interfingering of both Columbia and Sandy River deposits. Soil encountered was predominantly silt (ML) and sand (SP, SM). However, some of the silt and sand encountered was slightly coarser, had a grayish color, and resembled the material currently being deposited at the mouth of the Sandy River. Other silt and sand had a slightly finer texture, was dark brown in color, and resembled portions of the Willamette Silt, or finer portions of the Troutdale Formation seen in other areas. These darker sediments were likely deposited during

Columbia River flood events. The depth and extent of project area soil types have not been assessed.

Shallow Groundwater

Groundwater occurs at depths ranging from approximately 5 to 18 feet bgs (August 1994). Water levels in the Phase 1 monitoring wells (MW01 through MW08) declined an average of 3.5 feet from July to October.

Contours of the July 21, 1994, water level elevations measured in the Phase 1 monitoring wells are presented in Figure 3-2. The groundwater elevation data measured at the onsite monitoring wells indicate that, in general, shallow groundwater moves from the south or southeast to the north or northwest across the site. Groundwater elevation contours parallel the Columbia and Sandy Rivers near the riverbanks, and they take on a more northeast-southwest aspect farther from the rivers.

The most notable features apparent in this figure are the sink, or depression, in the water table surface in the vicinity of the scrap yard (near MW02) and the apparent mound in the water table surface near the wastewater treatment facility (near MW01). The water level elevation contour map presented in Figure 3-2 was used to assess the utility of the Phase 1 monitoring wells as monitoring locations downgradient of onsite areas of interest. On the basis of this assessment, monitoring wells MW09 through MW12 were installed. Water level elevation contours based on water levels collected from all 12 monitoring wells are presented in Figure 3-3.

Figure 3-3 shows that September water level elevations declined relative to the July levels, although the contour shapes and features of interest remained similar. The two elevations that remained relatively constant between the two dates are the Company Lake elevation and the water level elevation at MW01.

Scrap Yard Groundwater Depression

The depression near the scrap yard is defined primarily by water level elevations in MW02, MW07, and MW10. The actual center, or lowest point, of the depression cannot be determined with the resolution provided by the existing monitoring well network, although it appears to occur in the scrap yard east of the carbon plant. The result of the water table depression in the scrap yard area is that shallow groundwater flow appears to converge, at least locally, toward the scrap yard from all directions.

The cause of the depression is unknown. Because water level measurements in an unused deep well (PW06) indicate that deeper zone water level elevations (at least in the vicinity of the scrap yard) are roughly 6 to 8 feet lower than shallow water level elevations, a possible explanation is that shallow groundwater could be moving vertically downward in the vicinity of the scrap yard.

Wastewater Treatment Area Mound

The cause of the apparent mound in the vicinity of the ESP wastewater treatment system (near MW01) is also unknown. The water level elevation at MW01 has not decreased in a manner similar to the water levels in the other shallow monitoring wells. The source of the water affecting the water level elevation at MW01 cannot be determined with the resolution provided by the existing monitoring well network.

Company Lake

The water level elevation in Company Lake appears to be between 2 and 6 feet higher than the local water table elevations shown in Figure 3-2, and 5 to 9 feet higher than the water level elevations shown in Figure 3-3. The contours between MW07 and MW08 bend slightly to the northwest relative to the contours between MW07 and MW06, suggesting the potential for groundwater mounding beneath Company Lake. The presence of a groundwater mound cannot be assessed, however, with the resolution provided by the existing monitoring well network. The surface water elevation in Company Lake is stable (between 15.3 and 15.4 feet) and does not fluctuate with local water levels or river stage. The elevation of Company Lake appears to be controlled primarily by the inflow from the plant and the elevation of the weir at the outfall.

Bakehouse Area

A dewatering system designed to lower groundwater levels below the base of the cathode block bake-pits exists in and around the bakehouse. Dewatering sump and wellpoint locations, along with posted water level elevation data measured September 8, 1994, are shown in Figure 3-4. The dewatering sumps are approximately 4 feet in diameter and constructed of perforated concrete pipe sections. The sumps extend downward from roughly 14 to 21 feet bgs. Each sump is fitted with a float-switch-activated pump that discharges groundwater directly into onsite storm drains.

The wellpoints are capped 3-inch-diameter pipes that are approximately 30 feet deep. The wellpoints do not appear to be connected to any active pumping system, although some are connected to an unused manifold. It is possible that the wellpoints were installed as part of a construction dewatering network and then abandoned when construction was completed.

In general, sumps on the north and west sides of the bakehouse are dry, and sumps on the east and south contain water, which is to be expected if the water table generally slopes from southeast to northwest. Because factors that control measured water level elevations (such as pumping cycles and well construction) are unknown, and because some elevations appear anomalously high (Sump No. 7) or anomalously low (Wellpoint No. 19) the data presented in Figure 3-4 have not been contoured. However, when the average water level elevation in the bakehouse area (about 9 feet) is compared with the bakehouse area water level elevation contours presented in Figure 3-3 (14 to 16 feet), it appears that a groundwater depression

ALR 9293806.DWG
14-Oct-1994

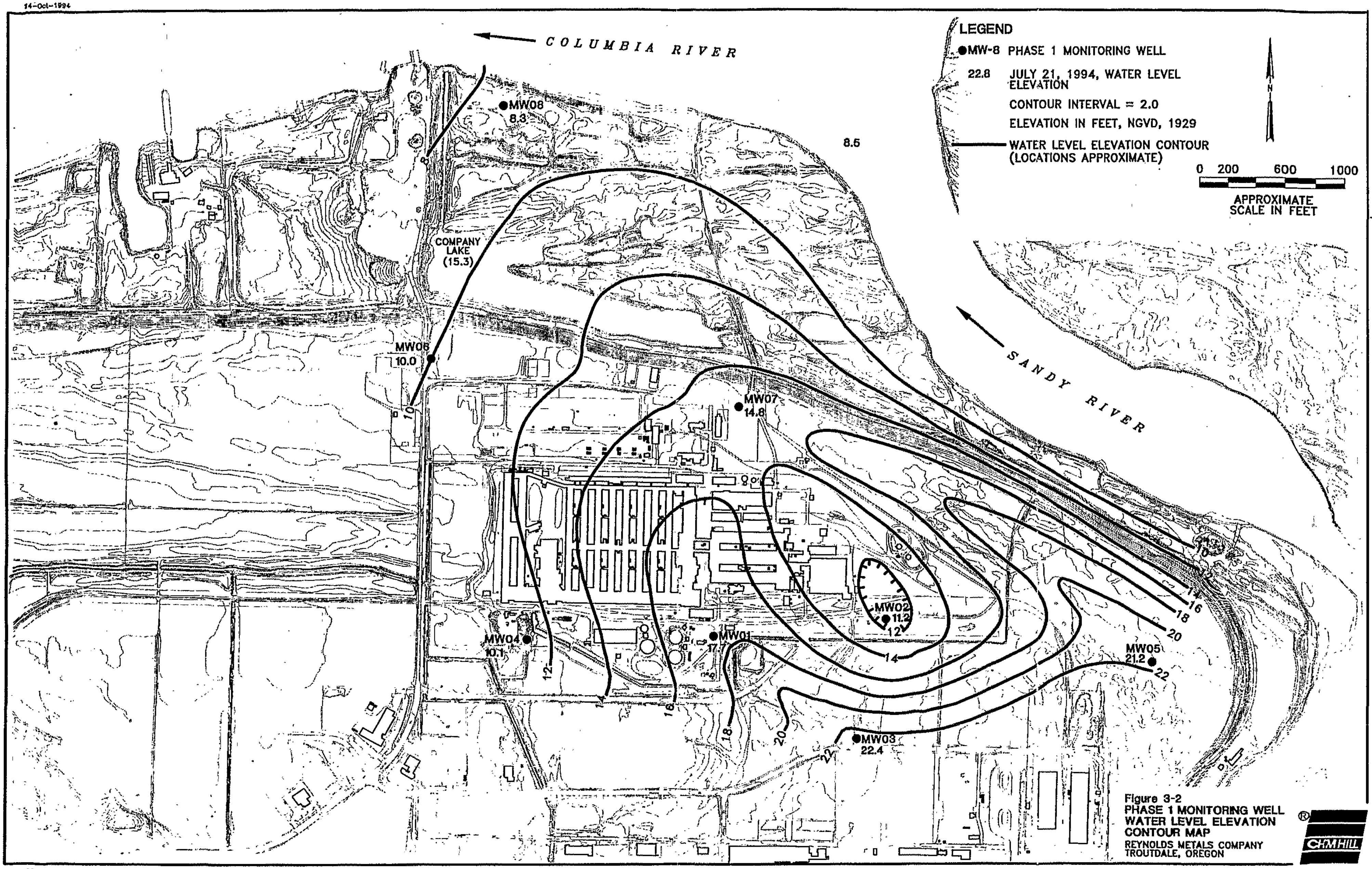

Figure 3-2
PHASE 1 MONITORING WELL WATER LEVEL ELEVATION CONTOUR MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
CH2M HILL

9293806.DWG

SRB 9293804.DWG
14-Oct-1994

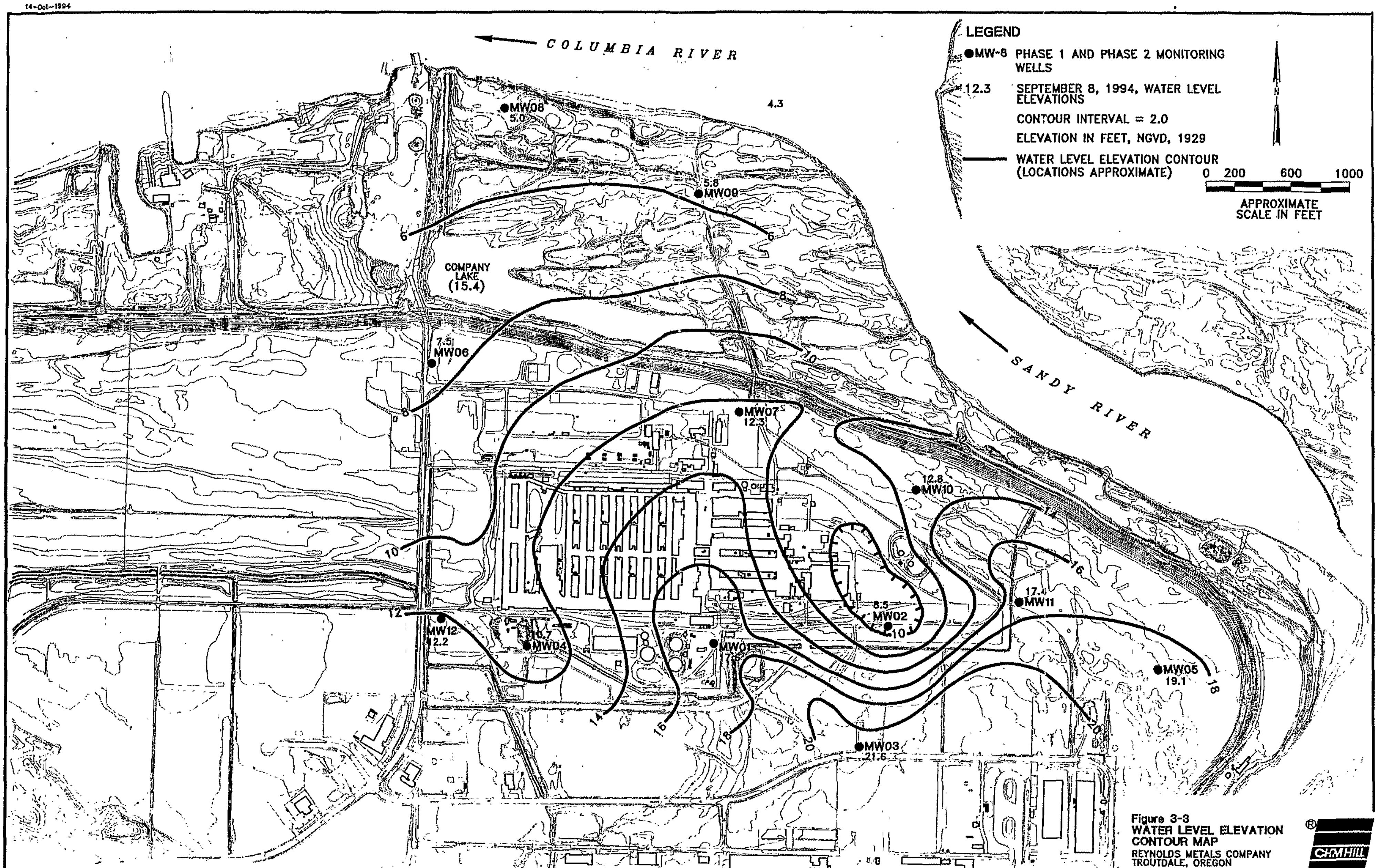

Figure 3-3
WATER LEVEL ELEVATION CONTOUR MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

CH2M HILL

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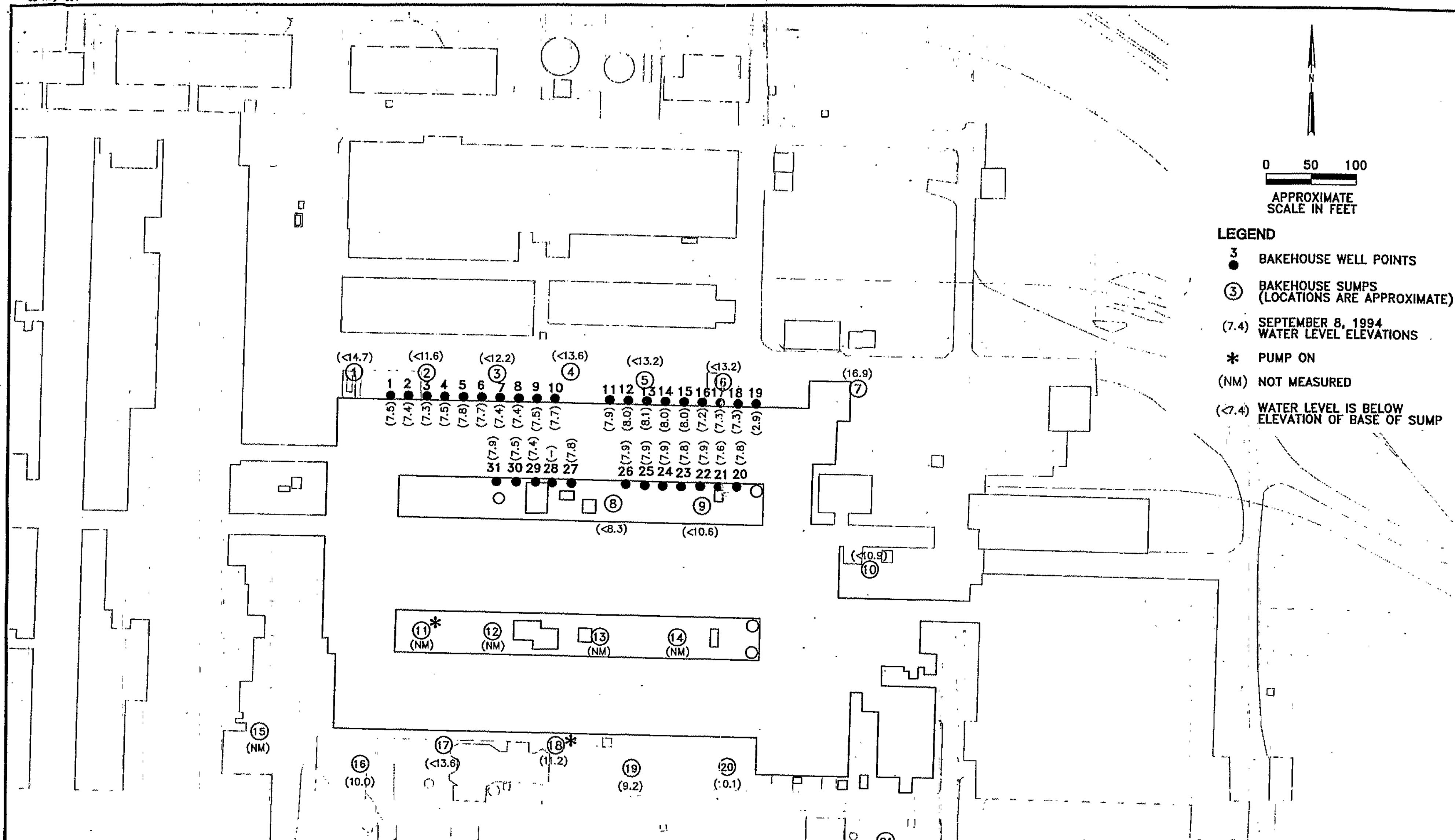

Figure 3-4
BAKEHOUSE WELL POINTS AND DEWATERING SUMPS WITH SEPT. 8, 1994, WATER LEVEL ELEVATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

9293W03.DWG

occurs in the vicinity of the bakehouse. The result of this depression is that groundwater flow, at least locally, converges toward the bakehouse in all directions.

Groundwater Analytical Results

The groundwater analytical program described below is presented in Table 3-2. Total cyanide was analyzed per EPA method 9010 as an indicator for the presence of cyanide amenable to chlorine, or free cyanide. Where total cyanide was detected, the free cyanide concentration was also analyzed. Free cyanide was measured for comparison with the drinking water MCL, which is based on cyanide amenable to chlorine.

Shallow Groundwater

Monitoring Wells

Groundwater samples were collected from the Phase 1 monitoring wells (MW01 through MW08) on July 19, 1994. Groundwater samples were collected from the Phase 2 well installations (MW09 through MW12), selected Phase 1 wells, and a shallow BPA monitoring well (BPAT-05) on August 15 and 16, 1994. Results of the analyses performed on these samples are presented in Table 3-3. Figure 3-5 shows cyanide, fluoride, pH, and electrical conductivity results at each monitoring well location.

The following discussion compares the shallow groundwater analytical results in Table 3-3 with published EPA drinking water MCLs. It has not been determined that drinking water MCLs are appropriate criteria for assessing the significance of constituent concentrations at the RMC facility. They are presented here for the purpose of discussion only.

Cyanide. Total cyanide was detected in only 5 of the 13 wells sampled in concentrations ranging from 0.68 mg/L (MW01) to 0.015 mg/L (MW09). At three of these locations, free cyanide was also detected (0.18, 0.015 and 0.04 mg/L at MW01, MW11 and MW09, respectively).

Fluoride. Fluoride was detected at 7 of the 13 locations sampled in concentrations ranging from 0.83 mg/L (BPAT-05) to 570 mg/L (MW11). Of the seven locations where fluoride was detected, six exceeded the drinking water MCL of 4.0 mg/L.

PAHs. Trace PAHs were detected in only one of the duplicate samples collected at MW02 during the first sampling event. This well was resampled for PAHs during the second sampling event, and no PAHs were detected.

PCBs. PCBs were not detected.

Metals. Specific metals exceeded drinking water MCLs at 3 of the 13 locations sampled:

Table 3-2
Groundwater Analytical Program Summary Table

Sample Type	Cyanide	Fluoride	PAH's	PCB's	Metals	TPH	VOC's	SVOC's	Pesticides
Phase 1 Shallow Groundwater	EPA 9010	EPA 340.2	EPA 8310	EPA 8080	EPA 6010, 7000 Series	OR-HCID (8015M)	NA	NA	NA
Phase 2 Shallow Groundwater	EPA 9010	EPA 340.2	EPA 8310	EPA 508	EPA 6010, 7000 Series	OR-HCID (8015M)	EPA 524.2	EPA 525.1	EPA 508
Bake-house sumps and wellpoints	EPA 9010	EPA 340.2	EPA 8310	NA	EPA 6010, 7000 Series (a)	OR-HCID (8015M)	NA	EPA 8270	NA
Deeper Groundwater	EPA 9010	EPA 340.2	EPA 8310	EPA 508	EPA 6010, 7000 Series	OR-HCID (8015M)	EPA 524.2	EPA 525.1	EPA 508
Offsite Samples	EPA 9010	EPA 340.2	NA	EPA 508	NA	NA	NA	EPA 525.1	NA

NA = Not Analyzed
(a) = Complete metals series at BS11 only. Aluminum and arsenic at all other bake-house locations.

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
Inorganics (mg/L)																					
Fluoride	0.83	24	22	22	22	21	0.5 U	0.5 U	11	110	0.5 U	0.5 U	0.5 U	4.7	4.9	29	29	0.5 U	570	0.5 U	0.5 U
Cyanide, Amenable		0.01 U	0.18	0.01 U	0.01 U				0.01 U	0.01 U						0.015	0.01 U		0.04		
Cyanide, Total	0.01 U	0.51	0.68	0.018	0.017	0.01 U	0.01 U	0.01 U	0.018	0.022	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015	0.015	0.01 U	0.72	0.01 U	0.01 U
Volatiles (ug/L)																					
1,1,1,2-Tetrachloroethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-Trichloroethane	0.1 U															0.11	0.15	0.1 U	0.1 U	0.1 U	0.91
1,1,2,2-Tetrachloroethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloroethane	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,1-Dichloroethane	0.1 U															0.26	0.26	0.1 U	0.1 U	0.1 U	0.1 U
1,1-Dichloroethene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,1-Dichloropropene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-Trichlorobenzene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-Trichloropropane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trichlorobenzene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,4-Trimethylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dibromo-3-chloropropane	0.5 U															0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichlorobenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichloroethane	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,2-Dichloropropane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-Trimethylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,3-Dichlorobenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,3-Dichloropropane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene	0.1 U															0.1 U	0.1 U	0.13	0.1 U	0.1 U	0.1 U
2,2-Dichloropropane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Chlorotoluene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-Chlorotoluene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Benzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Bromobenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Bromochloromethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromodichloromethane	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Bromoform	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromomethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Carbon Tetrachloride	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Chlorobenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Chloroethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chloroform	0.1 U															0.1 U	0.1 U	0.19	0.34	0.1 U	0.97
Chloromethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

U = non detects
Blank space = not analyzed

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
Volatiles (ug/L) - cont'd																					
Dibromochloromethane	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Dibromomethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dichlorodifluoromethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Ethylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Hexachlorobutadiene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Isopropylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Methylene Chloride	0.5 U															0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Naphthalene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Styrene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Tetrachloroethene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Toluene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.24
Trichloroethene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Trichlorofluoromethane	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Vinyl Chloride	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Xylenes (total)	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11
cis-1,2-Dichloroethene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
cis-1,3-Dichloropropene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
n-Butylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
n-Propylbenzene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
p-Isopropyltoluene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
sec-Butylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
tert-Butylbenzene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
trans1,2Dichloroethene	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
trans1,3Dichloropropene	0.2 U															0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
n-Propylbenzene																	0.2 U				
PAHs (ug/L)																					
Acenaphthene	5 U	1 U		1 U	1 U	1.2 U	1 U	1 U	1 U		1.1 U	1 U	1.1 U	1 U		1.1 U	1.1 U	1 U	1 U	1 U	1.2 U
Acenaphthylene	5 U	3 U		3 U	3 U	3.7 U	3 U	3 U	3 U		3.3 U	3 U	3.3 U	3 U		3.3 U	3.3 U	3 U	3 U	3 U	3.5 U
Anthracene	5 U	0.2 U		0.2 U	0.2 U	0.24 U	0.2 U	0.2 U	0.2 U		0.22 U	0.2 U	0.22 U	0.2 U		0.22 U	0.22 U	0.2 U	0.2 U	0.2 U	0.24 U
Benzo(a)anthracene	0.1 U	0.1 U		0.1 U	0.1	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Benzo(a)pyrene	0.1 U	0.1 U		0.1 U	0.14	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Benzo(b)fluoranthene	0.1 U	0.1 U		0.1 U	0.26	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Benzo(g,h,i)perylene	0.1 U	0.1 U		0.1 U	0.27	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Benzo(k)fluoranthene	0.1 U	0.1 U		0.1 U	0.1 U	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Chrysene	0.1 U	0.1 U		0.1 U	0.1 U	0.12 U	0.1 U	0.1 U	0.1 U		0.11 U	0.1 U	0.11 U	0.1 U		0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.12 U
Dibenzo(a,h)anthracene	0.1 U	0.2 U		0.2 U	0.2 U	0.24 U	0.2 U	0.2 U	0.2 U		0.22 U	0.2 U	0.22 U	0.2 U		0.22 U	0.22 U	0.2 U	0.2 U	0.2 U	0.24 U
Fluoranthene	0.1 U	1 U		1 U	1 U	0.61 U	1 U	1 U	1 U		1.1 U	1 U	1.1 U	1 U		0.55 U	0.56 U	0.5 U	0.5 U	0.5 U	0.59 U
Fluorene	5 U	0.5 U		0.5 U	0.5 U	0.61 U	0.5 U	0.5 U	0.5 U		0.55 U	0.5 U	0.55 U	0.5 U		0.55 U	0.56 U	0.5 U	0.5 U	0.5 U	0.59 U

U = non detects
Blank space = not analyzed

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
PAHs (ug/L) - cont'd																					
Indeno(1,2,3-cd)pyrene	0.1 U	0.2 U		0.2 U	0.2 U	0.24 U	0.2 U	0.2 U	0.2 U		0.22 U	0.2 U	0.22 U	0.2 U		0.22 U	0.22 U	0.2 U	0.2 U	0.2 U	0.24 U
Naphthalene	5 U	1 U		1 U	1 U	1.2 U	1 U	1 U	1 U		1.1 U	1 U	1.1 U	1 U		1.1 U	1.1 U	1 U	1 U	1 U	1.2 U
Phenanthrene	5 U	0.2 U		0.2 U	0.2 U	0.24 U	0.2 U	0.2 U	0.2 U		0.22 U	0.2 U	0.22 U	0.2 U		0.22 U	0.22 U	0.2 U	0.2 U	0.2 U	0.24 U
Pyrene	0.5 U	0.2 U		0.2 U	0.2 U	0.24 U	0.2 U	0.2 U	0.2 U		0.22 U	0.2 U	0.22 U	0.2 U		0.22 U	0.22 U	0.2 U	0.2 U	0.2 U	0.24 U
Semivolatiles/Pesticides (ug/L)																					
2,3-Dichlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
2,4,5-Trichlorophenol	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
2-Chlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Acenaphthylene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Alachlor	1 U															100 U	1 U	5 U	10 U	1 U	
Aldrin																			5 U		
Aldrin	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Anthracene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Atrazine	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Benzo(a)anthracene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Benzo(a)pyrene	0.2 U															20 U	0.2 U	1 U	2 U	0.2 U	
Benzo(b)fluoranthene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Benzo(g,h,i)perylene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Benzo(k)fluoranthene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Butylbenzylphthalate	5 U															500 U	5 U	25 U	50 U	5 U	
Chrysene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Di(2-ethylhexyl)adipate	1 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Di(2-ethylhexyl)phthalate	5 U															500 U	5 U	25 U	50 U	5 U	
Di-n-butylphthalate	2 U															200 U	2 U	10 U	20 U	2 U	
Dibenzo(a,h)anthracene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Diethylphthalate	2 U															200 U	2 U	10 U	20 U	2 U	
Dimethylphthalate	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Endrin	1.5 U															100 U	1 U	5 U	10 U	1 U	
Fluorene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Heptachlor	0.4 U															40 U	0.4 U	2 U	4 U	0.4 U	
Heptachlor Epoxide	0.2 U															20 U	0.2 U	1 U	2 U	0.2 U	
Heptachlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Hexachlorobenzene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Hexachlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Hexachlorocyclopentadiene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Indeno(1,2,3-cd)pyrene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Lindane	0.2 U															20 U	0.2 U	1 U	2 U	0.2 U	
Methoxychlor	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	

U = non detects
Blank space = not analyzed

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
Semivolatiles/Pesticides (ug/L) - cont'd																					
Octachlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Pentachlorophenol	2 U															200 U	2 U	10 U	20 U	2 U	
Phenanthrene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Pyrene	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Simazine	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Tetrachlorobiphenyl	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
a-Chlordane	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
g-Chlordane	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
trans-Nonachlor	0.5 U															50 U	0.5 U	2.5 U	5 U	0.5 U	
Pesticides (ug/L)																					
4,4'-DDD	0.04 U															0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
4,4'-DDE	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
4,4'-DDT	0.09 U															0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U
Aldrin	0.04 U															0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Chlordane(technical)	0.5 U															0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dieldrin	0.07 U															0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Endosulfan I	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Endosulfan II	0.05 U															0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan Sulfate	0.07 U															0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
Endrin	0.08 U															0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Endrin Aldehyde	0.08 U															0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
Heptachlor	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Heptachlor Epoxide	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Hexachlorobenzene	0.25 U															0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Methoxychlor	5 U															5 U	5 U	5 U	5 U	5 U	5 U
Toxaphene	5 U															5 U	5 U	5 U	5 U	5 U	5 U
Trifluralin	0.05 U															0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
a-Chlordane	0.02 U															0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
a-HCH	0.02 U															0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
b-HCH	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
d-HCH	0.02 U															0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
g-Chlordane	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
g-HCH	0.03 U															0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U

U = non detects
Blank space = not analyzed

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
PCBs (Method 508) (ug/L)																					
Aroclor 1016	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1221	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1232	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1242	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1248	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1254	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1260	0.1 U															0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PCBs (Method 8080) (ug/L)																					
Aroclor 1016		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1221		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1232		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1242		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1248		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1254		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
Aroclor 1260		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.55 U	0.55 U	0.55 U	0.5 U							
TPH (mg/L)																					
Diesel/related (C12-C24)		0.5 U		0.5 U	0.5 U		0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Heavy oil/related (C24-C40)		1 U		1 U	1 U		1 U	1 U	1 U		1 U	1 U	1 U	1 U		1 U	1 U	1 U	1 U	1 U	1 U
Gasoline		0.2 U		0.2 U	0.2 U		0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Dissolved Metals (mg/L)																					
Aluminum									4.8	22								0.1 U	65		
Antimony									0.005 U	0.005 U								0.0082	0.0072		
Arsenic									0.011	0.01								0.004 U	0.083		
Barium									0.22	0.2								0.02 U	0.9		
Beryllium									0.02 U	0.02 U								0.02 U	0.02 U		
Cadmium									0	0.0012								0.0003 U	0.0018		
Calcium									84	30								16	20		
Chromium									0.11	0.096								0.02 U	0.066		
Cobalt									0.05 U	0.05 U								0.05 U	0.059		
Copper									0.075	0.16								0.02 U	0.37		
Iron									33	6.7								0.1 U	6.7		
Lead									0.009	0.0072								0.004 U	0.056		
Magnesium									25	6.1								7.6	13		
Manganese									2.8	1.8								0.52	1.7		
Mercury									0.0005 U	0.0005 U								0.0005 U	0.001		
Nickel									0.05 U	0.05 U								0.05 U	0.22		
Potassium									6.5	6.2								2.7	9.6		

U = non detects
Blank space = not analyzed

Table 3-3
Shallow Groundwater Analytical Results

Sample Id and Date	BPA-MW5-81694	RM-MW01-71894	RM-MW01-81594	RM-MW02-71894	7-18-94 MW02 Duplicate	RM-MW02-81594	RM-MW03-71894	7-18-94 Equipment Blank	RM-MW04-71894	RM-MW04-81594	RM-MW05-71894	RM-MW06-71894	RM-MW07-71894	RM-MW08-71894	RM-MW08-81594	RM-MW09-81594	8-15-94 MW09 Duplicate	RM-MW10-81594	RM-MW11-81594	RM-MW12-81594	8-15-94 Equipment Blank
Dissolved Metals (mg/L) - cont'd																					
Selenium									0.004 U	0.004 U								0.004 U	0.008		
Silver									0.02 U	0.02 U								0.02 U	0.02 U		
Sodium									940	620								8.9	980		
Thallium									0.004 U	0.004 U								0.004 U	0.004 U		
Vanadium									0.29	0.38								0.02 U	0.51		
Zinc									0.05 U	0.05 U								0.05 U	0.11		
Total Metals (mg/L)																					
Aluminum	8.6	3.5		2.2	2.8		2	0.1 U	88	100	0.34	0.38	1.2	0.26		4.4	4.2	44	380	0.35	0.1 U
Antimony	0.005 U	0.005 U		0.005 U	0.005 U		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U	0.005 U	0.011	0.005 U	0.005 U
Arsenic	0.004 U	0.004 U		0.004 U	0.004 U		0.004 U	0.004 U	0.016	0.018	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U	0.017	0.16	0.004 U	0.004 U
Barium	0.1	0.02 U		0.034	0.036		0.032	0.02 U	0.8	0.78	0.026	0.02 U	0.044	0.052		0.021	0.02 U	0.52	3	0.021	0.02 U
Beryllium	0.02 U	0.02 U		0.02 U	0.02 U		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Cadmium	0.00025 U	0.00025 U		0.00025 U	0.0003 U		0.0003 U	0.0003 U	0.001	0.0014	0.0003 U	0.0003 U	0.0003 U	0.0003 U		0.0003 U	0.0003 U	0.0007	0.0035	0.0003 U	0.0003 U
Calcium	11	40		10	10		10	0.1 U	120	47	12	8.7	22	13		17	17	29	71	16	0.1 U
Chromium	0.02 U	0.02 U		0.02 U	0.02 U		0.02 U	0.02 U	0.22	0.21	0.02 U	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U	0.2	0.41	0.031	0.02 U
Cobalt	0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	0.05 U	0.12	0.09	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.085	0.22	0.05 U	0.05 U
Copper	0.02 U	0.02 U		0.02 U	0.02 U		0.02 U	0.02 U	0.28	0.26	0.02 U	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U	0.074	0.78	0.02 U	0.02 U
Iron	14	0.71		4.7	5.5		5	0.1 U	120	49	0.44	0.43	1.1	0.1 U		0.32	0.16	79	420	17	0.1 U
Lead	0.0089	0.004 U		0.004 U	0.004 U		0.004 U	0.004 U	0.05	0.039	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U	0.03	0.1	0.004 U	0.004 U
Magnesium	6.9	3.3		6.7	7		3	0.1 U	41	15	5.3	5.3	14	6.4		5	4.9	22	74	8.6	0.1 U
Manganese	0.33	0.15		0.37	0.36		0.26	0.02 U	4.9	2.5	0.02	0.062	0.056	0.04		0.05	0.02 U	1.8	7	0.9	0.02 U
Mercury	0.0005 U	0.0005 U		0.0005 U	0.0005 U		0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U		0.0005 U	0.0005 U	0.0005 U	0.0013	0.0005 U	0.0005 U
Nickel	0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	0.05 U	0.14	0.19	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.46	0.55	0.1	0.05 U
Potassium	1.8	3.9		1.4	3.1		3.9	1 U	14	11	2.7	1 U	1 U	1.7		3	3	7	41	1.6	1 U
Selenium	0.004 U	0.004 U		0.004 U	0.004 U		0.004 U	0.004 U	0.008	0.0045	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U	0.004 U	0.008	0.004 U	0.004 U
Silver	0.02 U	0.02 U		0.02 U	0.02 U		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Sodium	9.8	120		42	43		7.1	1 U	1000	660	5.8	5.9	10	42		140	140	13	890	100	2.1
Thallium	0.004 U	0.004 U		0.004 U	0.004 U		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Vanadium	0.021	0.02 U		0.02 U	0.02 U		0.02 U	0.02 U	0.62	0.62	0.02 U	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U	0.16	1.1	0.02 U	0.02 U
Zinc	0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	0.05 U	0.27	0.17	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.19	0.8	0.05 U	0.05 U

U = non detects

Blank space = not analyzed

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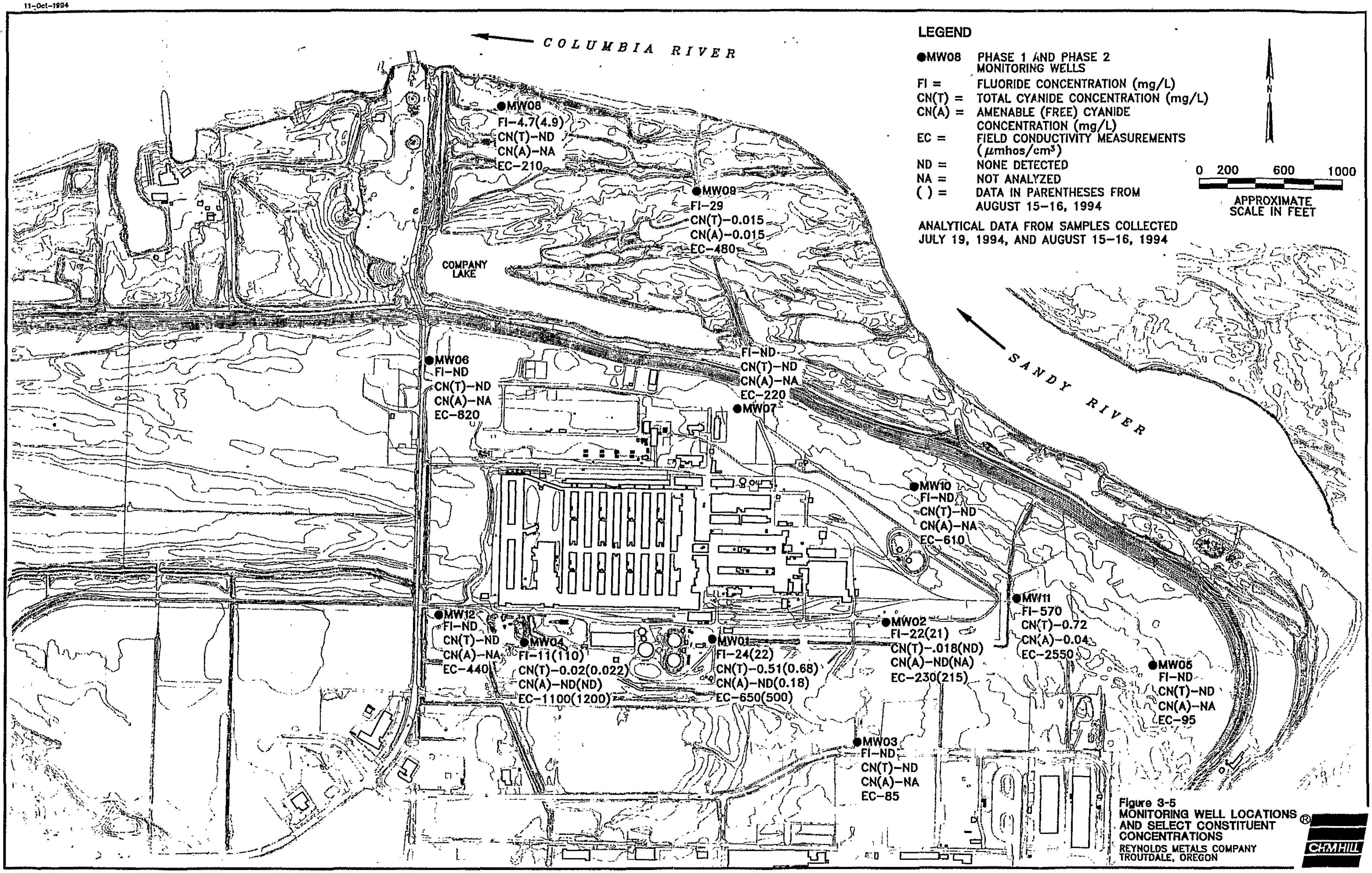

Figure 3-5
MONITORING WELL LOCATIONS AND SELECT CONSTITUENT CONCENTRATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

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- MW04 dissolved metals concentrations exceeded the 0.1-mg/L MCL for chromium in the first sampling event (0.11 mg/L), but not in the second sampling event (0.096 mg/L).

- MW10 dissolved antimony concentration (0.0082 mg/L) exceeded the MCL of 0.006 mg/L.

- At MW11 the dissolved antimony concentration (0.0072 mg/L) exceeded the MCL of 0.006 mg/L; the arsenic concentration (0.083 mg/L) exceeded the MCL of 0.05 mg/L); and the nickel concentration (0.22 mg/L) exceeded the MCL of 0.1 mg/L.

TPHs. Petroleum hydrocarbons were not detected.

VOCs. VOCs were detected at MW09, MW10, and MW11. Because the same VOCs were also detected in an equipment blank collected from a submersible pump, the only concentration that appears to qualify as a detection is .13 µg/L (ppm) 1,4-dichlorobenzene at MW10. This concentration is below the .75-µg/L drinking water MCL for 1,4-dichlorobenzene.

Semivolatile organic compounds (SVOCs). SVOCs were not detected.

Pesticides. Pesticides were not detected.

Bakehouse Sumps and Wellpoints

Water samples were collected from four of the dewatering sumps (BS11, BS16, BS18, and BS21) and one of the wellpoints (BWP3) in and around the bakehouse on August 25, 1994. These locations are shown in Figure 3-4. Analytical results are included in Table 3-4. The following discussion compares the shallow groundwater analytical results in Table 3-4 with published EPA drinking water MCLs.

Cyanide. Total cyanide was detected in two of the five locations sampled (0.19 mg/L at Sumps 11 and 18). No amenable (or free) cyanide was detected, and the MCL of 0.2 mg/L was not exceeded.

Fluoride. Fluoride was detected at all five locations in concentrations ranging from 1.4 mg/L (BWP3) to 140 mg/L (BS16). Of the five locations where fluoride was detected, three exceeded the drinking water MCL of 4.0 mg/L.

PAHs. PAHs were detected in four of the five locations sampled. At sumps 11, 16, and 18, individual PAH concentrations exceeded drinking water MCLs. The exeedances are described as follows:

Table 3-4
Bakehouse Water Analytical Results

Sample Id and Date	RM-BS11-82594		RM-BS16-82594		RM-BS18-82594		RM-BS21-82594		RM-BWP3-82594	
Inorganics (mg/L)										
Cyanide, Total	0.19		0.01	U	0.19		0.01	U	0.01	U
Cyanide, Amenable	0.19				0.19					
Fluoride	27		140		30		2.8		1.4	
Organics										
PAHs (ug/L)										
Acenaphthene	1	U	20	U	50	U	1	U	1.1	U
Acenaphthylene	3	U	60	U	150	U	3	U	3.3	U
Anthracene	0.2	U	4	U	14		0.2	U	0.22	U
Benzo(a)anthracene	0.15		41		120		0.1	U	0.11	U
Benzo(a)pyrene	0.19		15		81		0.15	U	0.17	U
Benzo(b)fluoranthene	0.21		46		200		0.2	U	0.22	U
Benzo(g,h,i)perylene	0.16		12		71		0.1	U	0.11	U
Benzo(k)fluoranthene	0.11		15		61		0.1	U	0.11	U
Chrysene	0.3	U	73		280		0.3	U	0.33	U
Dibenzo(a,h)anthracene	0.2	U	4	U	10	U	0.2	U	0.22	U
Fluoranthene	0.5	U	140		380		0.5	U	0.55	U
Fluorene	0.5	U	10	U	25	U	0.5	U	0.55	U
Indeno(1,2,3-cd)pyrene	0.2	U	11		60		0.2	U	0.22	U
Naphthalene	1	U	20	U	50	U	1	U	1.1	U
Phenanthrene	0.2	U	4	U	63		0.2	U	0.22	U
Pyrene	0.24		120		320		0.2	U	0.24	
Semivolatiles (ug/L)										
1,2,4-Trichlorobenzene	5	U	25	U	50	U	5	U	5.5	U
1,2-Dichlorobenzene	5	U	25	U	50	U	5	U	5.5	U
1,3-Dichlorobenzene	5	U	25	U	50	U	5	U	5.5	U
1,4-Dichlorobenzene	5	U	25	U	50	U	5	U	5.5	U
2,4,5-Trichlorophenol	5	U	25	U	50	U	5	U	5.5	U
2,4,6-Trichlorophenol	5	U	25	U	50	U	5	U	5.5	U
2,4-Dichlorophenol	5	U	25	U	50	U	5	U	5.5	U
2,4-Dimethylphenol	5	U	25	U	50	U	5	U	5.5	U
2,4-Dinitrophenol	10	U	50	U	100	U	10	U	11	U
2,4-Dinitrotoluene	5	U	25	U	50	U	5	U	5.5	U
2,6-Dinitrotoluene	5	U	25	U	50	U	5	U	5.5	U
2-Chloronaphthalene	5	U	25	U	50	U	5	U	5.5	U
2-Chlorophenol	5	U	25	U	50	U	5	U	5.5	U
2-Methylnaphthalene	5	U	25	U	50	U	5	U	5.5	U
2-Methylphenol	5	U	25	U	50	U	5	U	5.5	U
2-Nitroaniline	5	U	25	U	50	U	5	U	5.5	U
2-Nitrophenol	5	U	25	U	50	U	5	U	5.5	U

U = non detects
BS = Bakehouse sump
BWP = Bakehouse wellpoint
Blank space = not analyzed

Table 3-4
Bakehouse Water Analytical Results

Sample Id and Date	RM-BS11-82594		RM-BS16-82594		RM-BS18-82594		RM-BS21-82594		RM-BWP3-82594	
Semivolatiles (ug/L) - cont'd										
3,3'-Dichlorobenzidine	5	U	25	U	50	U	5	U	5.5	U
3-Nitroaniline	10	U	50	U	100	U	10	U	11	U
4,6-Dinitro-2-methylphenol	10	U	50	U	100	U	10	U	11	U
4-Bromophenyl Phenyl Ether	5	U	25	U	50	U	5	U	5.5	U
4-Chloro-3-methylphenol	5	U	25	U	50	U	5	U	5.5	U
4-Chloroaniline	20	U	100	U	200	U	20	U	22	U
4-Chlorophenyl Phenyl Ether	5	U	25	U	50	U	5	U	5.5	U
4-Methylphenol	5	U	25	U	50	U	5	U	5.5	U
4-Nitroaniline	10	U	50	U	100	U	10	U	11	U
4-Nitrophenol	10	U	50	U	100	U	10	U	11	U
Acenaphthene	5	U	25	U	50	U	5	U	5.5	U
Acenaphthylene	5	U	25	U	50	U	5	U	5.5	U
Anthracene	5	U	25	U	14	U	5	U	5.5	U
Benzo(a)anthracene	0.15	U	52		160		5	U	5.5	U
Benzo(a)pyrene	0.19	U	15	U	81		5	U	5.5	U
Benzo(b)fluoranthene	0.21	U	48		220		5	U	5.5	U
Benzo(g,h,i)perylene	0.16	U	12	U	65		5	U	5.5	U
Benzo(k)fluoranthene	0.11	U	15	U	60		5	U	5.5	U
Benzoic Acid	10	U	50	U	100	U	10	U	11	U
Benzyl Alcohol	10	U	50	U	100	U	10	U	11	U
Butylbenzyl Phthalate	5	U	25	U	50	U	5	U	5.5	U
Chrysene	5	U	68		290		5	U	5.5	U
Di-n-butylphthalate	5	U	25	U	50	U	5	U	5.5	U
Di-n-octylphthalate	5	U	25	U	50	U	5	U	5.5	U
Dibenzo(a,h)anthracene	5	U	25	U	50	U	5	U	5.5	U
Dibenzofuran	5	U	25	U	50	U	5	U	5.5	U
Diethylphthalate	5	U	25	U	50	U	5	U	5.5	U
Dimethylphthalate	5	U	25	U	50	U	5	U	5.5	U
Fluoranthene	5	U	180		420		5	U	5.5	U
Fluorene	5	U	25	U	50	U	5	U	5.5	U
Hexachlorobenzene	5	U	25	U	50	U	5	U	5.5	U
Hexachlorobutadiene	10	U	50	U	100	U	10	U	11	U
Hexachlorocyclopentadiene	10	U	50	U	100	U	10	U	11	U
Hexachloroethane	10	U	50	U	100	U	10	U	11	U
Indeno(1,2,3-cd)pyrene	5	U	11	U	52		5	U	5.5	U
Isophorone	5	U	25	U	50	U	5	U	5.5	U
N-Nitroso-di-n-propylamine	10	U	50	U	100	U	10	U	11	U
N-Nitrosodiphenylamine	5	U	25	U	50	U	5	U	5.5	U
Naphthalene	5	U	25	U	50	U	5	U	5.5	U

U = non detects
BS = Bakehouse sump
BWP = Bakehouse wellpoint
Blank space = not analyzed

Table 3-4
Bakehouse Water Analytical Results

Sample Id and Date	RM-BS11-82594		RM-BS16-82594		RM-BS18-82594		RM-BS21-82594		RM-BWP3-82594	
Semivolatiles (ug/L) - cont'd										
Nitrobenzene	5	U	25	U	50	U	5	U	5.5	U
Pentachlorophenol	10	U	50	U	100	U	10	U	11	U
Phenanthrene	5	U	25	U	71		5	U	5.5	U
Phenol	5	U	25	U	50	U	5	U	5.5	U
Pyrene	0.24	U	160		360		5	U	0.24	U
bis(2-Chloroethoxy)methane	10	U	50	U	100	U	10	U	11	U
bis(2-Chloroethyl)ether	5	U	25	U	50	U	5	U	5.5	U
bis(2-Chloroisopropyl)ether	10	U	50	U	100	U	10	U	11	U
bis(2-Ethylhexyl)phthalate	5	U	25	U	50	U	5	U	5.5	U
Total Metals (mg/L)										
Aluminum	3.2		4		6.6		0.1	U	0.47	
Antimony	0.005	U								
Arsenic	0.004	U	0.004	U	0.005		0.004	U	0.009	
Barium	0.029									
Beryllium	0.02	U								
Cadmium	0.00025	U								
Calcium	46									
Chromium	0.02	U								
Cobalt	0.05	U								
Copper	0.02	U								
Iron	0.1	U								
Lead	0.004	U								
Magnesium	23									
Manganese	0.02	U								
Mercury	0.0005	U								
Nickel	0.05	U								
Potassium	4.3									
Selenium	0.004	U								
Silver	0.02	U								
Sodium	1500									
Thallium	0.004	U								
Vanadium	0.02	U								
Zinc	0.05	U								

U = non detects
BS = Bakehouse sump
BWP = Bakehouse wellpoint
Blank space = not analyzed

Sump 11:

- The detected benzo(a)anthracene concentration of .15 µg/L exceeded the MCL of 0.1 µg/L.

- The detected benzo(b)fluoranthene concentration of 0.21 µg/L exceeded the MCL of 0.2 µg/L.

Sump 16:

- The detected benzo(a)anthracene concentration of 47 µg/L (value averaged from EPA Methods 8310 and 8270) exceeded the MCL of 0.1 µg/L.

- The detected benzo(a)pyrene concentration of 15 µg/L (detected with EPA Method 8310 only) exceeded the MCL of 0.2 µg/L.

- The detected benzo(b)fluoranthene concentration of 47 µg/L (value averaged from EPA Methods 8310 and 8270) exceeded the MCL of 0.2 µg/L.

- The detected benzo(k)fluoranthene concentration of 15 µg/L (detected with EPA Methods 8310 only) exceeded the MCL of 0.2 µg/L.

- The detected chrysene concentration of 71 µg/L (value averaged from EPA Methods 8310 and 8270) exceeded the MCL of 0.2 µg/L.

- The detected indeno(1,2,3,cd)pyrene concentration of 11 µg/L (detected with EPA Method 8310 only) exceeded the MCL of 0.4 µg/L.

Sump 18:

- The detected benzo(a)anthracene concentration of 140 µg/L (value averaged from EPA Methods 8310 and 8270) exceeded the MCL of 0.1 µg/L.

- The detected benzo(a)pyrene concentration of 81 µg/L exceeded the MCL of 0.2 µg/L.

- The detected benzo(b)fluoranthene concentration of 210 µg/L (value averaged from EPA Methods 8310 and 8270) exceeded the MCL of 0.2 µg/L.

- The detected benzo(k)fluoranthene concentration of 61 µg/L (detected with EPA Method 8310 only) exceeded the MCL of 0.2 µg/L.

- The detected chrysene concentration of 285 µg/L (value averaged with EPA Method 8310 and 8270) exceeded the MCL of 0.2 µg/L.

- The detected indeno(1,2,3,cd)pyrene concentration of 56 µg/L (detected with EPA Method 8310 only) exceeded the MCL of 0.4 µg/L.

Metals. No metals exceeded drinking water MCLs.

TPHs. Petroleum hydrocarbons registering in the diesel range were detected at 1.6 and 4.4 mg/L at Sumps 16 and 18. Petroleum hydrocarbons registering in the heavy oil range also were detected at 1.5 and 7.3 mg/L at Sumps 16 and 18.

SVOCs. The SVOCs detected with Method 8270 were PAHs and are discussed above.

A complete evaluation of the bakehouse sumps and wellpoints has not been completed. All points of entry and sources of potential influent have not been assessed. Because there are indications that process materials may have entered some of the sumps, it is possible that water pumped from the sumps does not accurately reflect groundwater conditions in the vicinity of the bakehouse.

Deeper Groundwater

Eighteen used and unused deeper production wells exist at the RMC site. The known or estimated locations of the wells are shown in Figure 3-6. Groundwater samples were collected from five of the RMC production wells on August 16, 1994 (PW03, PW07, PW08, PW10, and PW18). These wells range from 180 feet deep (PW10) to 280 feet deep (PW03). The shallowest screened interval occurs at PW18, 148 feet bgs. The deepest screened interval, 253 feet bgs, occurs at PW03.

Analytical results are presented in Table 3-5. Figure 3-7 shows cyanide, fluoride, pH, and electrical conductivity results at each sampled production well location. Available well logs are included in Appendix E.

Cyanide. Total cyanide was detected in only one of the five production wells sampled, 0.24 mg/L at PW18. No amenable (or free) cyanide was detected in that sample and, therefore, the MCL of 0.2 mg/L was not exceeded.

Fluoride. Fluoride was detected at two of the five production wells sampled in concentrations ranging from 0.64 mg/L (PW18) to 1.3 mg/L (PW08). Neither concentration exceeded the drinking water MCL of 4.0 mg/L.

PAHs. PAHs were not detected.

Metals. No specific metals analyzed exceeded drinking water MCLs.

TPHs. Petroleum hydrocarbons were not detected.

VOCs. VOCs were not detected.

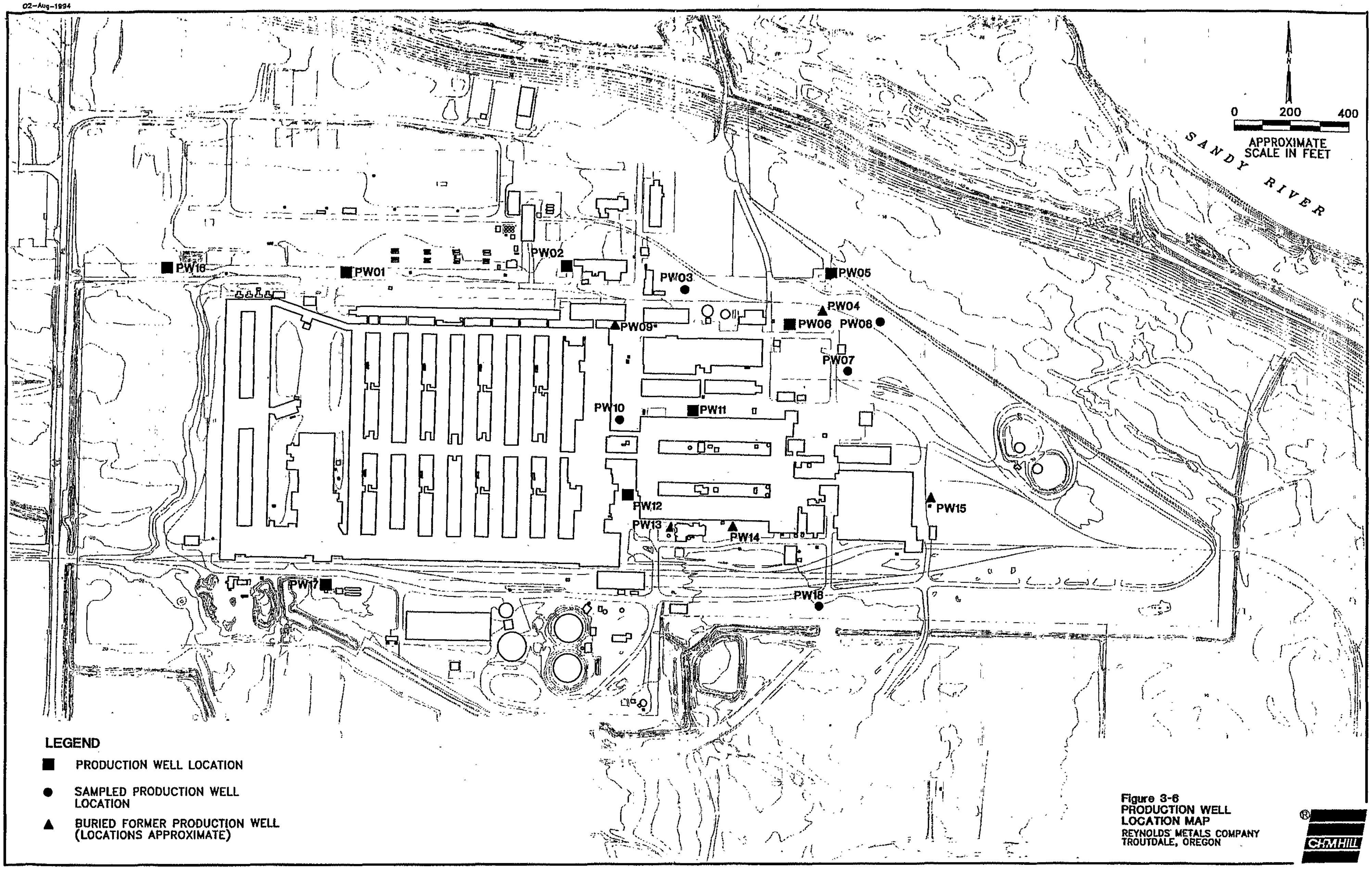

Figure 3-6
PRODUCTION WELL LOCATION MAP
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

Table 3-5
Deep Groundwater Analytical Results

Sample Id and Date	RM-PW03-81694		RM-PW07-81694		RM-PW08-81694		RM-PW10-81694		RM-PW18-81694		PW18 Duplicate	
Inorganics (mg/L)												
Cyanide, Total	0.01	U	0.01	U	0.01	U	0.01	U	0.024		0.023	
Cyanide, Amenable									0.01	U	0.01	U
Fluoride	0.5	U	0.5	U	1.3		0.5	U	0.64		0.68	
Organics												
Volatiles (ug/L)												
1,1,1,2-Tetrachloroethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,1,1-Trichloroethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,1,2,2-Tetrachloroethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,1,2-Trichloroethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,1-Dichloroethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,1-Dichloroethene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,1-Dichloropropene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,2,3-Trichlorobenzene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,2,3-Trichloropropane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,2,4-Trichlorobenzene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,2,4-Trimethylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,2-Dibromo-3-chloropropane	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
1,2-Dibromoethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,2-Dichlorobenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,2-Dichloroethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,2-Dichloropropane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,3,5-Trimethylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,3-Dichlorobenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,3-Dichloropropane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
1,4-Dichlorobenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
2,2-Dichloropropane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
2-Chlorotoluene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
4-Chlorotoluene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Benzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Bromobenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Bromochloromethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Bromodichloromethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Bromoform	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Bromomethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Carbon Tetrachloride	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chlorobenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloroethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Chloroform	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chloromethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Dibromochloromethane	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Dibromomethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Dichlorodifluoromethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Ethylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Hexachlorobutadiene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Isopropylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Methylene Chloride	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Naphthalene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Styrene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Tetrachloroethene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Toluene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Trichloroethene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

U = non detects

Blank space = not analyzed

Table 3-5
Deep Groundwater Analytical Results

Sample Id and Date	RM-PW03-81694		RM-PW07-81694		RM-PW08-81694		RM-PW10-81694		RM-PW18-81694		PW18 Duplicate	
Volatiles (ug/L) - cont'd												
Trichlorofluoromethane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vinyl Chloride	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Xylenes (total)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
cis-1,2-Dichloroethene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
cis-1,3-Dichloropropene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
n-Butylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
n-Propylbenzene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
p-Isopropyltoluene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
sec-Butylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
tert-Butylbenzene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
trans1,2Dichloroethene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
trans1,3Dichloropropene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
PAHs (ug/L)												
Acenaphthene	5	U	5	U	5	U	5	U	5	U	5	U
Acenaphthylene	5	U	5	U	5	U	5	U	5	U	5	U
Anthracene	5	U	5	U	5	U	5	U	5	U	5	U
Benzo(a)anthracene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(a)pyrene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(b)fluoranthene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(g,h,i)perylene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo(k)fluoranthene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Chrysene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Dibenzo(a,h)anthracene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Fluoranthene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Fluorene	5	U	5	U	5	U	5	U	5	U	5	U
Indeno(1,2,3-cd)pyrene	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Naphthalene	5	U	5	U	5	U	5	U	5	U	5	U
Phenanthrene	5	U	5	U	5	U	5	U	5	U	5	U
Pyrene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Semivolatiles/Pesticides (ug/L)												
2,3-Dichlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
2,4,5-Trichlorophenol	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
2-Chlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Acenaphthylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Alachlor	1	U	1	U	1	U	1	U	1	U	1	U
Aldrin	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Anthracene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Atrazine	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Benzo(a)anthracene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Benzo(a)pyrene	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Benzo(b)fluoranthene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Benzo(g,h,i)perylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Benzo(k)fluoranthene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Butylbenzylphthalate	5	U	5	U	5	U	5	U	5	U	5	U
Chrysene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Di(2-ethylhexyl)adipate	1	U	1	U	1	U	1	U	1	U	1	U
Di(2-ethylhexyl)phthalate	5	U	5	U	5	U	5	U	5	U	5	U
Di-n-butylphthalate	2	U	2	U	2	U	2	U	2	U	2	U
Dibenzo(a,h)anthracene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Diethylphthalate	2	U	2	U	2	U	2	U	2	U	2	U
Dimethylphthalate	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Endrin	1	U	1	U	1	U	1	U	1	U	1	U

U = non detects

Blank space = not analyzed

Table 3-5
Deep Groundwater Analytical Results

Sample Id and Date	RM-PW03-81694		RM-PW07-81694		RM-PW08-81694		RM-PW10-81694		RM-PW18-81694		PW18 Duplicate	
Semivolatiles/Pesticides (ug/L) - cont'd												
Fluorene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Heptachlor	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U
Heptachlor Epoxide	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Heptachlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Hexachlorobenzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Hexachlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Hexachlorocyclopeniadiene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Indeno(1,2,3-cd)pyrene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Lindane	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Methoxychlor	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Octachlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Pentachlorophenol	2	U	2	U	2	U	2	U	2	U	2	U
Phenanthrene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Pyrene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Simazine	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Tetrachlorobiphenyl	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
a-Chlordane	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
g-Chlordane	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
trans-Nonachlor	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Pesticides (Method 508) (ug/L)												
4,4'-DDD	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
4,4'-DDE	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
4,4'-DDT	0.09	U	0.09	U	0.09	U	0.09	U	0.09	U	0.09	U
a-Chlordane	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
a-HCH	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Aldrin	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
b-HCH	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
Chlordane(technical)	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U
d-HCH	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Dieldrin	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
Endosulfan I	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
Endosulfan II	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Endosulfan Sulfate	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U
Endrin	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Endrin Aldehyde	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
g-Chlordane	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
g-HCH	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
Heptachlor	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
Heptachlor Epoxide	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U
Hexachlorobenzene	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
Methoxychlor	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U
Toxaphene	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U
Trifluralin	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
PCBs (Method 508) (ug/L)												
Aroclor 1016	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1221	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1232	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1242	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1248	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1254	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1260	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U

U = non detects
Blank space = not analyzed

Table 3-5
Deep Groundwater Analytical Results

Sample Id and Date	RM-PW03-81694		RM-PW07-81694		RM-PW08-81694		RM-PW10-81694		RM-PW18-81694		PW18 Duplicate	
TPH (ug/L)												
Diesel/related (C12-C24)	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Heavy oil/related (C24-C40)	1	U	1	U	1	U	1	U	1	U	1	U
Gasoline	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Total Metals (mg/L)												
Aluminum	0.1	U	0.1	U	0.1	U	0.61		0.1	U	0.15	
Antimony	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U
Arsenic	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Barium	0.025		0.02	U	0.02	U	0.069		0.02	U	0.02	U
Beryllium	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Cadmium	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U	0.00025	U
Calcium	26		20		25		84		13		13	
Chromium	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Cobalt	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Copper	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Iron	0.23		0.25		1.8		0.43		1.6		1.7	
Lead	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Magnesium	5.2		2.4		6.6		5.1		4.1		3.6	
Manganese	0.26		0.16		0.63		0.12		0.42		0.42	
Mercury	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U
Nickel	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Potassium	4.2		3.6		3.2		5.6		1		1	U
Selenium	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Silver	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Sodium	15		17		13		98		7.9		8.4	
Thallium	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U	0.004	U
Vanadium	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Zinc	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U

U = non detects

Blank Space = not analyzed

SRB 9293807.DWG
07-Oct-1994

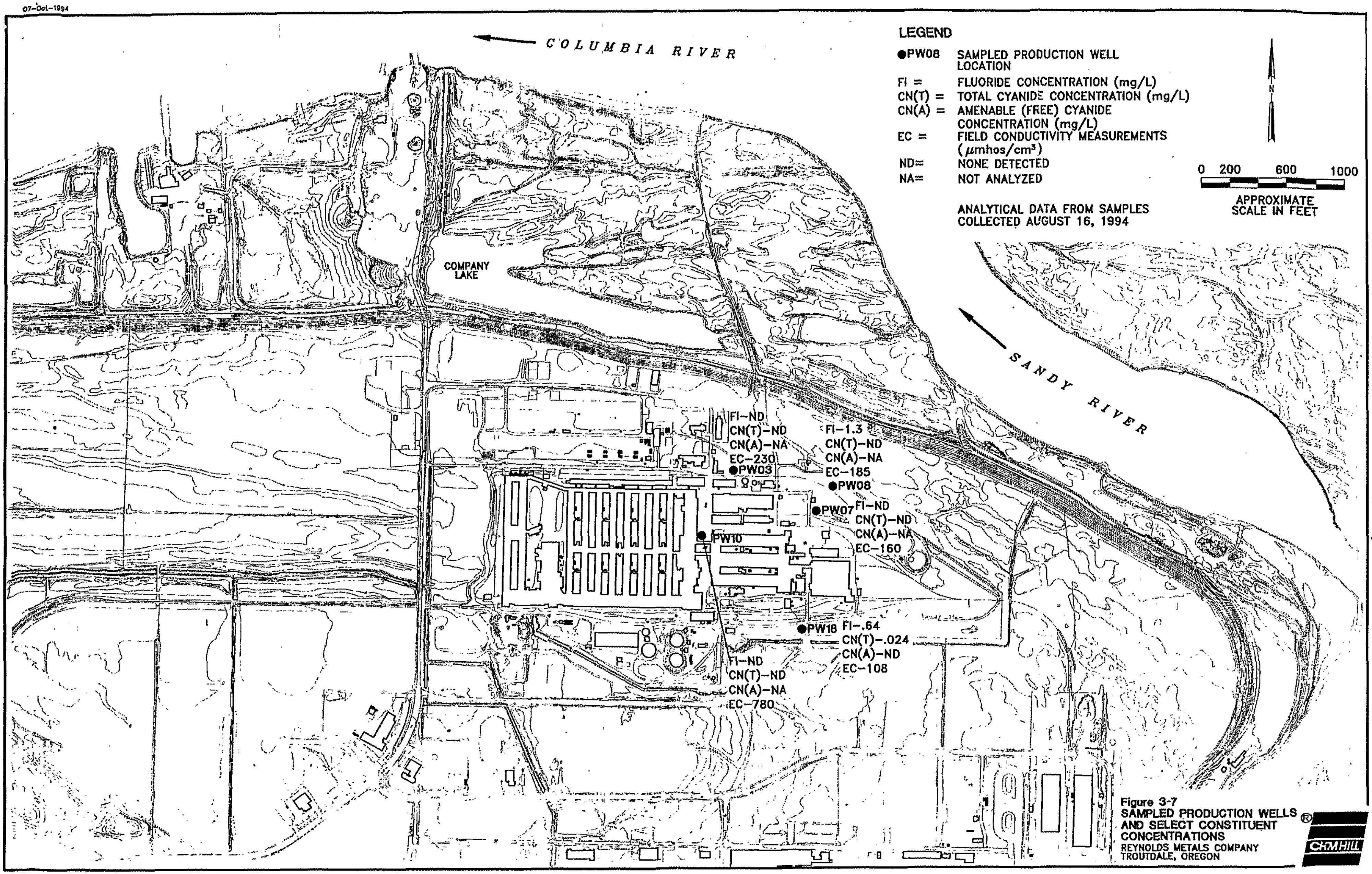

Figure 3-7
SAMPLED PRODUCTION WELLS AND SELECT CONSTITUENT CONCENTRATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

CH2M HILL

9293807.DWG

SVOCs. SVOCs were not detected.

Pesticides. Pesticides were not detected.

Offsite Groundwater

Three samples were collected from offsite locations west and northwest of the RMC facility on August 25, 1994. On the basis of the shallow monitoring well water levels measured onsite, these locations appear to be downgradient of the RMC facility. The three well locations are described below:

- Fairview Farms. This well is an unused irrigation well on property owned by Reynolds Metals Company approximately 1/2 mile west of Sundial Road and 760 feet south of the COE flood control dike. The well is reported to be 200 feet deep and screened from 119 to 200 feet bgs.

- Sundial Marine. This well is used for drinking water, potable supply for barges and tugs, and process water at this facility. The well lies approximately 1/3 mile west of the Company Lake outfall ditch, and 40 feet south of the Columbia River. The well is reported to be 233 feet deep and screened from 228 to 233 feet bgs.

- Gresham Sand and Gravel. This well is a domestic supply well. This well provided water for a single residence (currently unoccupied) and the office of the sand and gravel operation. The well is reported to be 130 feet deep and screened from 120 to 130 feet bgs.

Analytical results for these samples are included in Table 3-6. The well locations, along with posted fluoride, cyanide, and field conductivity data, are shown in Figure 3-8. Well logs are included in Appendix E. The analytical results are described as follows:

Cyanide. Cyanide was not detected.

Fluoride. Fluoride was not detected.

PCBs. PCBs were not detected.

SVOCs. SVOCs were not detected.

Borehole Soil

Borehole soil samples were collected at each monitoring well location. In general, samples from the surface, from a midpoint between the surface and the water table, and from the water table surface were submitted for analysis. Soil samples submitted for analysis were screened

Table 3-6
Offsite Groundwater Analytical Results

Sample Id and Date	RM-FF1-9694 (Fairview Farms)		RM-GS1-9694 (Gresham S&G)		RM-SM1-9694 (Sundial Marine)	
Inorganics (mg/L)						
Cyanide, Total	0.01	U	0.01	U	0.01	U
Fluoride	0.5	U	0.5	U	0.5	U
Organics						
Semivolatiles/Pesticides (ug/L)						
2,3-Dichlorobiphenyl	0.5	U	0.5	U	0.5	U
2,4,5-Trichlorophenol	0.5	U	0.5	U	0.5	U
2-Chlorobiphenyl	0.5	U	0.5	U	0.5	U
Acenaphthylene	0.5	U	0.5	U	0.5	U
Alachlor	1	U	1	U	1	U
Aldrin	0.5	U	0.5	U	0.5	U
Anthracene	0.5	U	0.5	U	0.5	U
Atrazine	0.5	U	0.5	U	0.5	U
Benzo(a)anthracene	0.5	U	0.5	U	0.5	U
Benzo(a)pyrene	0.2	U	0.2	U	0.2	U
Benzo(b)fluoranthene	0.5	U	0.5	U	0.5	U
Benzo(g,h,i)perylene	0.5	U	0.5	U	0.5	U
Benzo(k)fluoranthene	0.5	U	0.5	U	0.5	U
Butylbenzylphthalate	5	U	5	U	5	U
Chrysene	0.5	U	0.5	U	0.5	U
Di(2-ethylhexyl)adipate	0.5	U	0.5	U	0.5	U
Di(2-ethylhexyl)phthalate	5	U	5	U	5	U
Di-n-butylphthalate	2	U	2	U	2	U
Dibenzo(a,h)anthracene	0.5	U	0.5	U	0.5	U
Diethylphthalate	2	U	2	U	2	U
Dimethylphthalate	0.5	U	0.5	U	0.5	U
Endrin	1	U	1	U	1	U
Fluorene	0.5	U	0.5	U	0.5	U
Heptachlor	0.4	U	0.4	U	0.4	U
Heptachlor Epoxide	0.2	U	0.2	U	0.2	U
Heptachlorobiphenyl	0.5	U	0.5	U	0.5	U
Hexachlorobenzene	0.5	U	0.5	U	0.5	U
Hexachlorobiphenyl	0.5	U	0.5	U	0.5	U
Hexachlorocyclopeniadiene	0.5	U	0.5	U	0.5	U
Indeno(1,2,3-cd)pyrene	0.5	U	0.5	U	0.5	U
Lindane	0.2	U	0.2	U	0.2	U
Methoxychlor	0.5	U	0.5	U	0.5	U
Octachlorobiphenyl	0.5	U	0.5	U	0.5	U
Pentachlorophenol	2	U	2	U	2	U
Phenanthrene	0.5	U	0.5	U	0.5	U
Pyrene	0.5	U	0.5	U	0.5	U
Simazine	0.5	U	0.5	U	0.5	U
Tetrachlorobiphenyl	0.5	U	0.5	U	0.5	U
a-Chlordane	0.5	U	0.5	U	0.5	U
g-Chlordane	0.5	U	0.5	U	0.5	U
trans-Nonachlor	0.5	U	0.5	U	0.5	U

U = non detects
Blank space = not analyzed

Table 3-6
Offsite Groundwater Analytical Results

Sample Id and Date	RM-FF1-9694 (Fairview Farms)		RM-GS1-9694 (Gresham S&G)		RM-SM1-9694 (Sundial Marine)	
PCBs (ug/L)						
Aroclor 1016	1.1	U	1	U	1.1	U
Aroclor 1221	2.2	U	2	U	2.2	U
Aroclor 1232	1.1	U	1	U	1.1	U
Aroclor 1242	1.1	U	1	U	1.1	U
Aroclor 1248	1.1	U	1	U	1.1	U
Aroclor 1254	1.1	U	1	U	1.1	U
Aroclor 1260	1.1	U	1	U	1.1	U

U = non detects

Blank space = not analyzed

for PAHs, PCBs, and TPHs using modified standard laboratory methods. Soil samples were also analyzed for cyanide and fluoride using standard laboratory methods. Ten percent of the samples submitted for laboratory screening analysis were confirmed with full analytical methodologies.

Analytical results are presented in Table 3-7. A map showing surface concentrations of cyanide, fluoride, total PAHs (TPAH), PCBs, and aluminum is shown in Figure 3-9. In general, more soluble and therefore mobile constituents (cyanide, fluoride) exhibited the highest concentrations below the surface (at 2.5 or 5.0 feet bgs). Where detected, the constituents that are relatively less mobile in soils (PAHs, PCBs) generally exhibited the highest concentrations at the surface.

Summary and Conclusions

Summary

The groundwater elevation data indicate that, in general, shallow groundwater moves from the south or southeast to the north or northwest across the site. This pattern varies near the rivers, near the scrap yard area where a depression in the water table exists, near the wastewater treatment plant where MW01 appears to define a mound (or high) in the water table surface, and near the bakehouse where a dewatering system creates a depression in the water table surface. Shallow groundwater at the site is influenced by the water levels of the Columbia and Sandy Rivers.

Shallow groundwater appears to have been affected by facility operations in some areas, but not in others. Some exceedances of drinking water criteria (EPA drinking water MCLs) for some constituents have been noted, although these generally do not occur near the site boundaries. The significance of exceeding drinking water MCLs has not been evaluated. Because the sumps near the bakehouse are active dewatering sumps (water is pumped from them) and there are indications that materials may have been placed in some of the sumps, it is possible that water pumped from the sumps does not accurately reflect groundwater conditions in the vicinity of the bakehouse.

Deep groundwater collected at onsite well PW18 contained 0.64 mg/L fluoride and 0.024 mg/L cyanide. Onsite well PW08 contained fluoride at 1.8 mg/L. These constituents were detected in both wells at concentrations less than the drinking water MCLs. Groundwater samples collected from three offsite locations do not appear to have been affected by facility operations.

Work in Progress

Water level elevation monitoring at the site continues. Beginning in November 1994, manual measurements will be collected monthly, although several data loggers will remain in place to collect more frequent measurements at key locations. The water level data will be

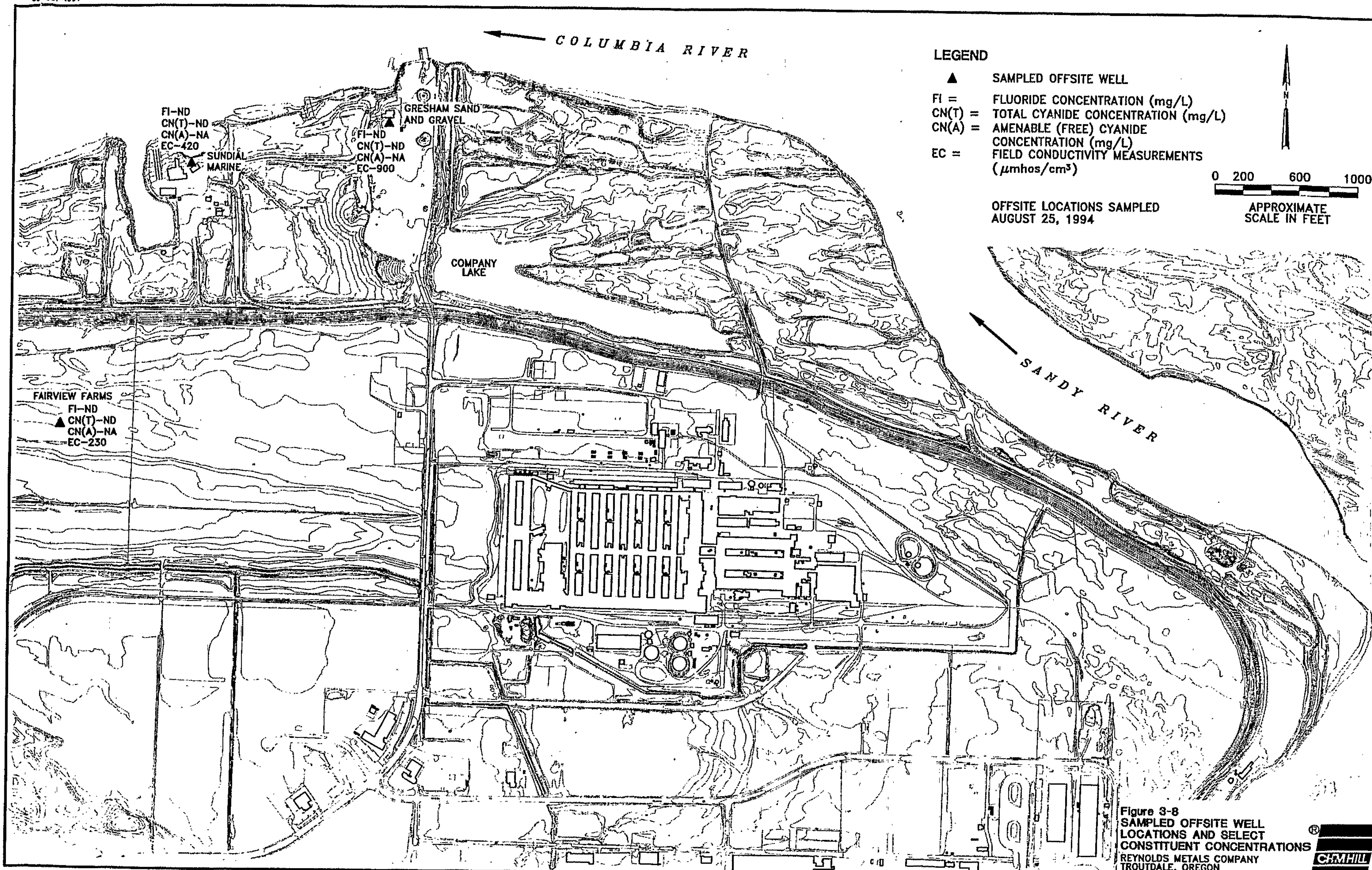

Figure 3-8
SAMPLED OFFSITE WELL LOCATIONS AND SELECT CONSTITUENT CONCENTRATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON
CH2M HILL

Table 3-7
Borehole Soil Analytical Results

Sample Id	RM-MW01-S	MW01-S Duplicate	RM-MW01-2.5	RM-MW01-7.5	MW01-10.0	MW01-12.5	RM-MW02-S	RM-MW02-2.5	RM-MW02-7.5	RM-MW02-12.5	RM-MW03-S	RM-MW03-2.5
Inorganics												
Fluoride	370	180	8.7	24			27	180	88	82	12	5 U
Cyanide, Total	3.2	3.4	0.12	7.4			0.16	0.1 U	0.38	0.32	0.28	0.1 U
Organics												
Total PAHs	38	49	0.2 U	0.2 U	9.9	0.2 U	37	0.2 U	0.2 U	0.2 U	1.3	0.2 U
Acenaphthene	0.2			0.0067 U								
Acenaphthylene	0.067 U			0.0067 U								
Anthracene	0.36			0.0067 U								
Benzo(a)anthracene	2.3			0.021								
Benzo(a)pyrene	2.6			0.026								
Benzo(b)fluoranthene	4.4			0.048								
Benzo(g,h,i)perylene	2.5			0.025								
Benzo(k)fluoranthene	1			0.015								
Chrysene	2.7			0.027								
Dibenzo(a,h)anthracene	0.58			0.0067 U								
Fluoranthene	3.5			0.032								
Fluorene	0.067 U			0.0067 U								
Indeno(1,2,3-cd)pyrene	2			0.017								
Naphthalene	0.067 U			0.0067 U								
Phenanthrene	1.2			0.0067 U								
Pyrene	2.3			0.03								
PCBs												
Total PCBs	0.2 U	0.2 U	0.2 U	0.2 U			1	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Aroclor 1016	0.05 U			0.05 U								
Aroclor 1221	0.1 U			0.1 U								
Aroclor 1232	0.05 U			0.05 U								
Aroclor 1242	0.05 U			0.05 U								
Aroclor 1248	0.05 U			0.05 U								
Aroclor 1254	0.05 U			0.05 U								
Aroclor 1260	0.26			0.05 U								
TPH												
TPH	160			20 U								
Diesel	50 U	50 U	50 U	50 U			50 U	50 U	50 U	50 U	50 U	50 U
Gasoline	20 U	20 U	20 U	20 U			20 U	20 U	20 U	20 U	20 U	20 U
Heavy/Bunker	140	150	100 U	100 U			500 >	100 U	100 U	100 U	100 U	100 U
Confirmation Results												
Gasoline	2 U			2 U								
Diesel/related	47			25 U								
Total Metals												
Aluminum	26000	27000	13000				13000	12000				
Antimony	2.5 U	2.5 U	2.5 U				2.5 U	2.5 U				
Arsenic	3.9	3.8	2.6				2.8	0.2 U				
Barium	49	44	83				44	34				
Beryllium	1 U	1 U	1 U				1 U	1 U				
Cadmium	1 U	1 U	1 U				1 U	1 U				
Calcium	7000	5800	4200				4500	3800				
Chromium	20	21	11				16	5.3				
Cobalt	9.6	9.6	5.4				6.3	2.5 U				
Copper	48	76	20				39	14				
Iron	17000	16000	18000				30000	12000				
Lead	28	34	10 U				18	10 U				
Magnesium	4400	2200	3200				1700	1700				
Manganese	160	160	140				170	78				
Mercury	0.25 U	0.25 U	0.25 U				0.25 U	0.25 U				
Nickel	55	45	6.7				66	4.7				
Potassium	420	350	660				340	340				
Selenium	1 U	1 U	1 U				1 U	1 U				
Silver	1 U	1 U	1 U				1 U	1 U				
Sodium	3300	1200	1200				1000	1100				
Thallium	1 U	1 U	1 U				1 U	1 U				
Vanadium	49	52	51				81	34				
Zinc	34	33	35				32	18				

Sample Id	RM-MW04-S	RM-MW04-2.5	RM-MW04-7.5	RM-MW04-10.0	RM-MW05-2.5	RM-MW06-S	RM-MW06-2.5	RM-MW06-7.5	RM-MW07-S	RM-MW07-2.5	MW07-2.5 Duplica	RM-MW07-7.5	RM-MW07-10.0
Inorganics													
Fluoride	130	140	210	200	5 U	5 U	5 U	5 U	6.8	5 U	11	5 U	5 U
Cyanide, Total	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Organics													
Total PAHs	12	1.4	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.95	0.2 U	0.2 U	0.2 U	0.2 U
Acenaphthene	0.067 U												
Acenaphthylene	0.067 U												
Anthracene	0.08												
Benzo(a)anthracene	0.83												
Benzo(a)pyrene	1.1												
Benzo(b)fluoranthene	2.8												
Benzo(g,h,i)perylene	2.1												
Benzo(k)fluoranthene	0.76												
Chrysene	2												
Dibenzo(a,h)anthracene	0.48												
Fluoranthene	0.96												
Fluorene	0.067 U												
Indeno(1,2,3-cd)pyrene	1.5												
Naphthalene	0.067 U												
Phenanthrene	0.23												
Pyrene	0.7												
PCBs													
Total PCBs	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.38	0.2 U	0.2 U	0.2 U	0.2 U
Aroclor 1016	0.05 U												
Aroclor 1221	0.1 U												
Aroclor 1232	0.05 U												
Aroclor 1242	0.05 U												
Aroclor 1248	1.2												
Aroclor 1254	0.05 U												
Aroclor 1260	0.26												
TPH													
TPH	49												
Diesel	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Gasoline	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Heavy/Bunker	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	1000 >	100 U	100 U	100 U	100 U
Confirmation Results													
Gasoline	2 U												
Diesel/related	25 U												
Total Metals													
Aluminum	46000	20000				5900	4700			8000	7300		
Antimony	2.5 U	2.5 U				2.5 U	2.5 U			2.5 U	2.5 U		
Arsenic	2.4	3.4				1.2	1 U			2.2	1 U		
Barium	56	120				43	22			48	36		
Beryllium	1 U	1 U				1 U	1 U			1 U	1 U		
Cadmium	1 U	1 U				1 U	1 U			1 U	1 U		
Calcium	6400	6000				1900	2900			2800	3000		
Chromium	8.8	13				10	8			13	12		
Cobalt	14	5.1				6.5	5			7.1	6.2		
Copper	29	32				19	16			19	16		
Iron	14000	15000				11000	9300			13000	13000		
Lead	14	10 U				10 U	10 U			10 U	10 U		
Magnesium	2100	3900				1100	1700			2200	1600		
Manganese	160	120				150	95			150	130		
Mercury	0.25 U	0.25 U				0.25 U	0.2 U			0.25 U	0.25 U		
Nickel	25	32				7.3	4.5			7.5	2.5 U		
Potassium	540	580				390	50 U			580	480		
Selenium	1 U	1 U				1 U	1 U			1 U	1 U		
Silver	1 U	1 U				1 U	1 U			1 U	1 U		
Sodium	770	1300				430	270			350	470		
Thallium	1 U	1 U				1 U	1 U			1 U	1 U		
Vanadium	49	56				43	29			46	51		
Zinc	34	42				23	15			25	23		

Units = mg/Kg
U = non detects
> = greater than
Blank space = not analyzed

Table 3-7
Borehole Soil Analytical Results

Sample Id	RM-MW08-S	RM-MW08-2.5	RM-MW09-S	RM-MW09-2.5	RM-MW09-17.5	RM-MW10-S	RM-MW10-2.5	RM-MW10-7.5	RM-MW10-10	RM-MW11-S	RM-MW11-2.5	RM-MW11-5.0	RM-MW11-7.5	RM-MW12-S	RM-MW12-7.5
Inorganics															
Fluoride	10 U	10 U	5.9		44	5 U		5 U	5 U	28		1600	360	19	71
Cyanide, Total	0.2	0.1 U	0.19		0.1 U	0.17		0.1 U	0.1 U	0.46		1	1.1	0.41	0.1 U
Organics															
Total PAHs	0.2 U	0.2 U	6.6		0.2 U	9.4		0.2 U	0.2 U	110 >		0.2 U	0.2 U	4.2	0.2 U
Acenaphthene			0.036	0.0067 U		0.099	0.0067 U			0.26	0.0067 U			0.038	
Acenaphthylene			0.0067 U	0.0067 U		0.067 U	0.0067 U			0.067 U	0.0067 U			0.0067 U	
Anthracene			0.061	0.0067 U		0.13	0.0067 U			0.46	0.0067 U			0.043	
Benzo(a)anthracene			0.64	0.0067 U		0.99	0.0067 U			4.1	0.013			0.43	
Benzo(a)pyrene			0.83	0.0067 U		1.3	0.0067 U			4.3	0.02			0.52	
Benzo(b)fluoranthene			1.6	0.0067 U		1.7	0.008			8.5	0.048			0.71	
Benzo(g,h,i)perylene			0.54	0.0067 U		1	0.0067 U			4.4	0.028			0.25	
Benzo(k)fluoranthene			0.41	0.0067 U		0.49	0.0067 U			1.7	0.01			0.22	
Chrysene			0.75	0.0067 U		1.3	0.0067 U			5.8	0.013			0.44	
Dibenzo(a,h)anthracene			0.22	0.0067 U		0.22	0.0067 U			1	0.0067 U			0.1	
Fluoranthene			0.73	0.0067 U		1.4	0.0067 U			4.7	0.014			0.55	
Fluorene			0.018	0.0067 U		0.067 U	0.0067 U			0.097	0.0067 U			0.014	
Indeno(1,2,3-cd)pyrene			0.61	0.0067 U		0.81	0.0067 U			3.9	0.022			0.3	
Naphthalene			0.0067 U	0.0067 U		0.067 U	0.0067 U			0.067 U	0.0067 U			0.0067 U	
Phenanthrene			0.24	0.0067 U		0.54	0.0067 U			1.7	0.0067 U			0.19	
Pyrene			0.64	0.0067 U		1.4	0.0067 U			5	0.015			0.45	
PCBs															
Total PCBs	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U		0.2 U	0.2 U	1.1		0.2 U	0.2 U	0.2 U	0.2 U
Aroclor 1016			0.05 U			0.05 U				0.05 U				0.05 U	
Aroclor 1221			0.1 U			0.1 U				0.1 U				0.1 U	
Aroclor 1232			0.1 U			0.05 U				0.05 U				0.05 U	
Aroclor 1242			0.06 U			0.05 U				0.05 U				0.05 U	
Aroclor 1248			0.15 U			0.05 U				0.05 U				0.05 U	
Aroclor 1254			0.15 U			0.05 U				0.05 U				0.05 U	
Aroclor 1260			0.2 U			0.05 U				1.2				0.05 U	
TPH															
TPH			35			87				430				33	
Diesel	50 U	50 U	50 U		50 U	50 U		50 U	50 U	50 U		50 U	50 U	50 U	50 U
Gasoline	20 U	20 U	20 U		20 U	20 U		20 U	20 U	20 U		20 U	20 U	20 U	20 U
Heavy/Bunker	100 U	100 U	100 U		100 U	100 U		100 U	100 U	1700		100 U	100 U	100 U	100 U
Confirmation Results															
Gasoline			2 U			2 U				2 U				2 U	
Diesel/related			33			30				170				25 U	
Total Metals															
Aluminum			11000			14000				7200		27000	19000	12000	15000
Antimony			2.5 U			2.5 U				2.5 U		2.5 U	2.5 U	2.5 U	2.5 U
Arsenic			2.2			2.6				4.1		3.3	2.3	3.3	2.5
Barium			81			85				53		190	130	54	120
Beryllium			1 U			1 U				1 U		1 U	1 U	1 U	1 U
Cadmium			1 U			1 U				1 U		1 U	1 U	1 U	1 U
Calcium			5100			4700				3400		6700	4700	3600	4000
Chromium			14			16				16		35	27	11	19
Cobalt			11			3.4				2.5 U		8.3	5.2	9.5	17
Copper			28			22				470		21	12	25	29
Iron			18000			18000				15000		35000	27000	14000	18000
Lead			24			11				100		17	10 U	17	15
Magnesium			3600			3900				1500		8000	6100	1900	5000
Manganese			300			240				160		530	430	180	130
Mercury			0.25 U			0.25 U				0.25 U		0.25 U	0.2 U	0.25 U	0.25 U
Nickel			15			14				22		24	17	22	18
Potassium			910			1200				220		2700	2000	610	220
Selenium			1 U			1 U				1 U		1 U	1 U	1 U	1 U
Silver			1 U			1 U				1 U		1 U	1 U	1 U	1 U
Sodium			480			720				430		8300	4700	600	1100
Thallium			1 U			1 U				1 U		1 U	1 U	1 U	1 U
Vanadium			46			49				36		83	68	45	64
Zinc			78			54				86		91	63	36	61

Units = mg/Kg
U = non detects
> = greater than
Blank space = not analyzed

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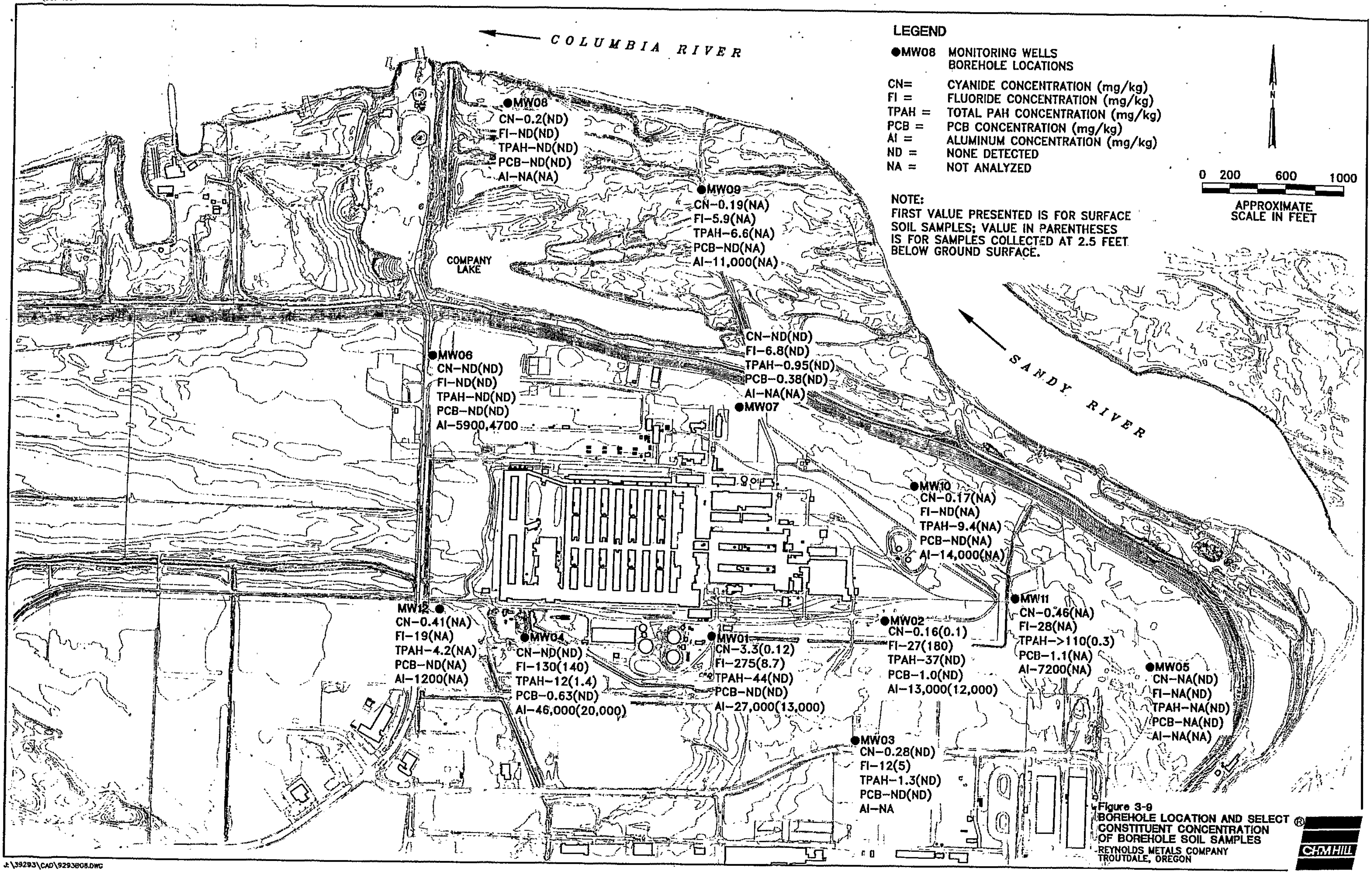

Figure 3-9
BOREHOLE LOCATION AND SELECT CONSTITUENT CONCENTRATION OF BOREHOLE SOIL SAMPLES
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

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evaluated to assess the relationship between groundwater and surface water, shallow groundwater and deeper groundwater, and seasonal variation in groundwater movement. Deep water levels will be measured at RMC production wells to assess flow directions in the deeper zones. This information will be used to develop a conceptual hydrogeologic model for the project area, and will be included in a later report.

The cause of the depression in the water table surface in the vicinity of the scrap yard is under investigation. One potential cause of the depression is the presence of one or more former production wells that have not been abandoned, which could potentially provide a conduit for the vertical migration of groundwater. The location and condition of any unabandoned wells in the vicinity of the scrap yard will be assessed, and plans for abandonment and monitoring will be developed.

The cause of the groundwater mound in the vicinity of the wastewater treatment system is under investigation. A leaking water supply main north of the wastewater treatment system will be repaired and the effects of this repair will be evaluated. In addition, recent changes in the operation of the treatment system could have temporarily affected water levels in the area. Frequent water level measurements at MW01 will be used to evaluate any changes in water level elevation that might result from stabilization of clarifier operations and, later, repair of the leaking water supply system.

The bakehouse sumps and wellpoints will be evaluated to assess all potential points of inflow and outflow. High-frequency water level monitoring at some sump locations may lead to a better understanding of the water level elevations in the bakehouse area. The results of this evaluation may lead to additional water and sediment sampling and removal of sediment from selected sumps. The wellpoint construction will be evaluated to assess the need for abandonment.

The work descrbed above will be combined with an assessment of area geology, hydrogeology, review of existing literature and information, and development of hydrostratigraphic cross sections to develop a conceptual hydrogeologic model for the site and vicinity. This evaluation will be included in a later report.

Section 4
Sediments and Surface Water

Sediment and surface water samples were collected from drainages at and adjacent to the plant site. Sampled areas, as shown in Figure 4-1, include the Columbia River, Company Lake, Salmon Creek, and East Lake.

Field Methods and Analytical Procedures

Field sampling methods and analytical procedures for the sediment and surface water investigation are summarized below.

Sampling Methodology

Discrete surface water samples were collected in each location prior to sediment sampling. Surface water was collected at each sampling location in a clean, decontaminated sample container. The sample was then transferred from this container into appropriate sample bottles as required for each requested analysis. Sample preservative, where necessary, was added to the sample bottles by the laboratory prior to their use in the field.

Discrete sediment samples were collected at all locations with an Eckman dredge. In most locations, use of the dredge resulted in collection of a sample from the top 1 to 2 inches of sediment. Because of the soft bottom in Company Lake, the top 6 inches of sediment were collected for Company Lake sediments. The contents of the Eckman dredge were emptied into a clean stainless steel bowl and mixed well before sample containers were filled. Large leaves and woody material were removed from the sediments before the sample containers were filled.

Analytical Procedures

Analytical procedures used for analysis of sediment samples were the same as for soil and debris samples and are discussed in Section 2. Analytical procedures used for the analysis of surface water are the same as for groundwater and are discussed in Section 3.

Investigation Results

Columbia River

This section summarizes work performed to collect sediment and surface water samples in the Columbia River. Samples were collected in two locations:

- Upriver of the Company Lake outfall

- At the Company Lake outfall in both upstream and downstream locations

Analytical data for samples collected in the Columbia River are provided in Tables 4-1 and 4-2.

Summary of Previous Sampling

No previous Columbia River sampling was conducted by EPA related to the Troutdale facility. Considerable sampling of the Columbia River has occurred for other studies and is available. These data were not researched for inclusion in this report.

Work Performed

In total, four sediment samples and two surface water samples were collected from the Columbia River. Two sediment samples (RM-SD1 and RM-SD2) and one surface water sample (RM-SW1) were collected from the Columbia River upstream of the RMC outfall. RM-SD1 and RM-SW1 were collected about 3 to 4 miles upriver of the plant, on the south bank, in about 12 feet of water. RM-SD2 was collected about 2 miles upriver, on the south bank, in about 3 feet of water.

Two sediment samples (RM-SD3 and RM-SD4) and one surface water sample (RM-SW3) were collected at the Company Lake outfall. Samples RM-SD3 and RM-SW3 were collected about 100 feet upstream of the outfall. RM-SD-4 was collected about 200 feet downstream of the outfall. Both samples were collected on the south bank in about 9 to 10 feet of water.

Samples were tested for cyanide, fluoride, PAH species, PCBs, metals, total organic carbon (TOC), and TPH (gasoline, diesel, and total).

Field Observations

The bottom characteristic for the upriver Columbia River sediment samples was sandy. Field observations suggest that RM-SD2 contained somewhat more organic matter than RM-SD1. This observation is supported by TOC measurements of 1,200 and 3,900 mg/kg for RM-SD2 and RM-SD1, respectively.

The bottom characteristic for the Company Lake outfall sediment samples was also sandy with some organic material. Sediment at RM-SD4 also contained small woody material. TOC measurements in the outfall sediments were 4,000 and 8,900 mg/kg for RM-SD3 and RM-SD4, respectively.

Summary of Sampling Results

Upriver Columbia sediment samples RM-SD1 and RM-SD2 showed similar constituent concentrations, with the exception of PAHs. Both samples showed no detectable levels of cyanide, fluoride, or PCBs (any aroclor). Metal concentrations are as shown in Table 4-1.

Total PAHs (determined as a sum of species) were found at a concentration of about 1.1 mg/kg in sample RM-SD2. These data suggest background PAH presence in Columbia River sediments.

Company Lake outfall sediment samples RM-SD3 and RM-SD4 generally showed concentrations similar to those of upriver sediment sample RM-SD2. RM-SD3, which is upstream of the outfall, showed detectable fluoride. RM-SD3 contained total PAH concentrations (0.19 mg/kg) lower than those in RM-SD2. RM-SD4, downstream of the outfall, showed no detectable fluoride and lower levels (including more nondetects) of total PAHs (0.10 mg/kg).

Columbia River surface water samples RM-SW1 and RM-SW3 showed no detectable levels of cyanide, fluoride, or PAHs. Metal concentrations were as shown in Table 4-2. No difference was noted between the upstream outfall surface water sample and the upriver Columbia surface sample.

Company Lake

Company Lake is the receiving water body for most site drainage from the Troutdale facility. Stormwater runoff, process cooling water, and wastewater treatment plant effluent are pumped from a ditch south of the plant to Company Lake. There is a discharge ditch (with a Parshall flume in it) that runs from Company Lake to the outfall on the Columbia River. The Company Lake outfall is a single pipe discharging to the river at a point currently above water level. Analytical data related to samples collected in Company Lake are provided in Tables 4-3 and 4-4.

Summary of Previous Sampling

EPA contract personnel collected five sediment samples along the length of the lake. Samples were analyzed for VOCs, PAHs, and metals. More than 10,000 mg/kg of total PAHs were detected in one sample collected near the influent to Company Lake. PAHs and metals were found in all samples. Fluoride at concentrations up to 127 mg/kg was also detected.

Work Performed

CH2M HILL personnel collected six sediment samples: one (RM-SD5) in the outfall ditch prior to discharge to the Columbia River, and five (RM-SD6 to RM-SD10) in the lake. All samples in Company Lake were collected from a boat in mid-lake areas. RM-SD5 was collected at a 3.5-foot depth by wading into the discharge ditch. A duplicate sediment sample was collected at RM-SD5. Water depths at sample locations in Company Lake ranged from 4 to 15 feet. Surface water samples were collected in three locations (RM-SW5, RM-SW6, and RM-SW10).

Samples were tested for total cyanide, fluoride, PAH species, PCB aroclors, metals, TOC, and TPH (gasoline, diesel, and total).

Table 4-3
Company Lake Sediment Analytical Results

Sample Id	RM-SD5		RM-SD5D		RM-SD6		RM-SD7		RM-SD8		RM-SD9		RM-SD10	
Inorganics														
Cyanide, Total	0.5	U	0.5	U	0.5	U	0.5	U	10		0.5	U	0.5	U
Fluoride	1200		780		1600		1800		780		1200		5800	
TOC	28000		32000		210000		180000		87000		240000		130000	
Organics														
Acenaphthene	1.7	U	1.7	U	12	U	1.7	U	0.78		7.8	U	0.34	U
Acenaphthylene	1.7	U	1.7	U	12	U	1.7	U	0.067	U	7.8	U	0.34	U
Anthracene	1.7	U	7.2		12	U	47		3.2		180		15	
Benzo(a)anthracene	110		100		1700		620		43		2400		270	
Benzo(a)pyrene	120		120		1800		600		40		2400		220	
Benzo(b)fluoranthene	250		270		4600		1400		82		5800		550	
Benzo(g,h,i)perylene	81		75		1200		380		27		1500		210	
Benzo(k)fluoranthene	69		75		1100		380		24		1500		210	
Chrysene	260		260		4400		1400		92		5800		620	
Dibenzo(a,h)anthracene	22		23		360		100		7.6		440		64	
Fluoranthene	66		50		540		220		27		1100		92	
Fluorene	1.7	U	1.7	U	12	U	1.7	U	0.067	U	7.8	U	0.34	U
Indeno(1,2,3-cd)pyrene	75		75		1100		360		28		1500		210	
Naphthalene	1.7	U	1.7	U	12	U	1.7	U	0.067	U	7.8	U	0.34	U
Phenanthrene	1.7	U	1.7	U	12	U	1.7	U	4.3		100		12	
Pyrene	56		41		470		200		28		820		100	
PCBs														
Aroclor 1016	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1221	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1232	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1242	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1248	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1254	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1260	0.31		0.34		2		3.5		2.8		2.8		2	

Units = mg/Kg
U = non detects
Blank space = not analyzed

SRB 9293W04.DWG
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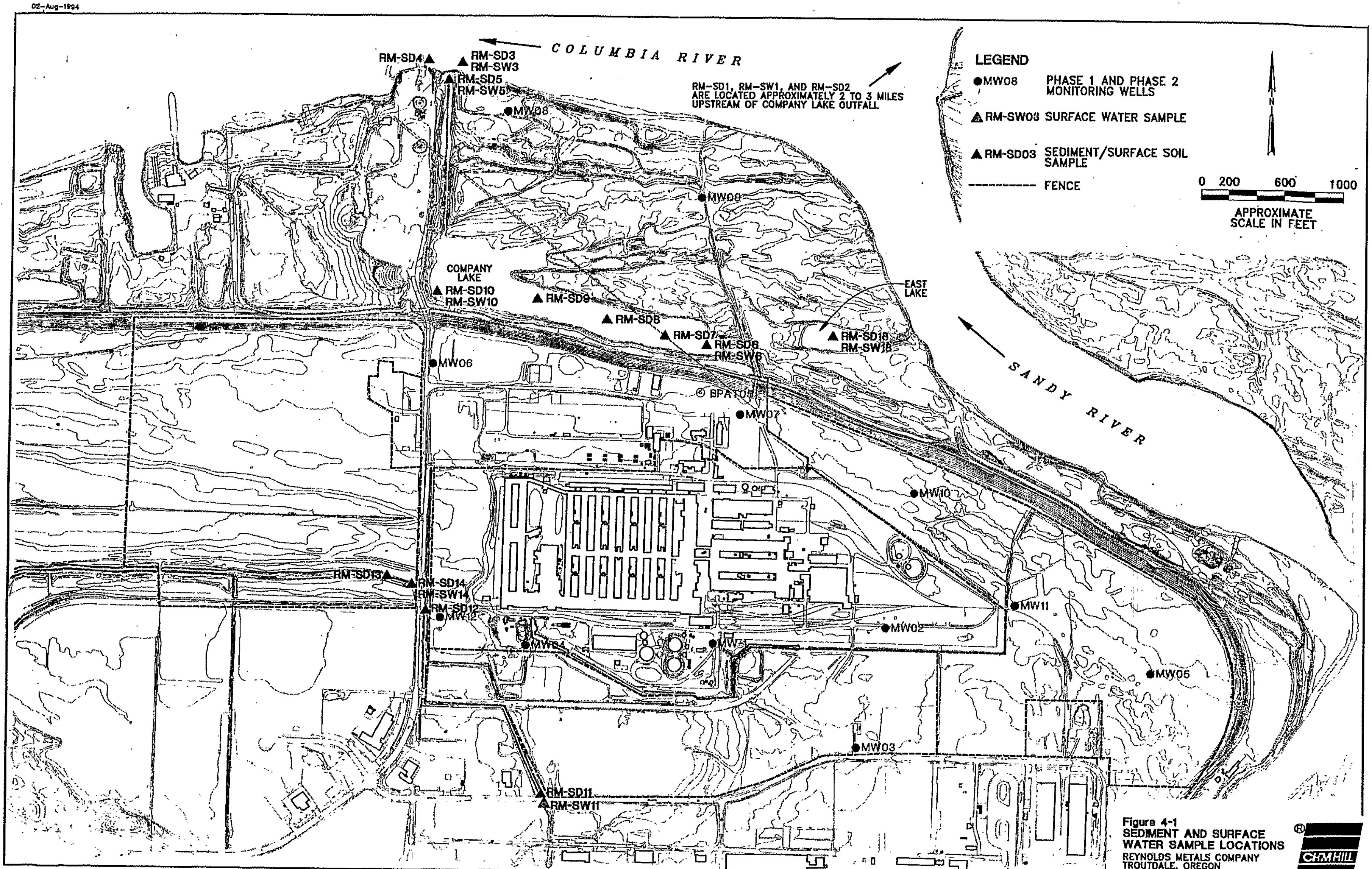

Figure 4-1
SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS
REYNOLDS METALS COMPANY
TROUTDALE, OREGON

9293W04.DWG

Table 4-1
Columbia River Sediment Analytical Results

Sample Id	RM-SD1		RM-SD2		RM-SD3		RM-SD4	
Inorganics								
Cyanide, Total	0.1	U	0.1	U	0.1	U	0.1	U
Fluoride	5	U	5	U	13		5	U
TOC	1200		3900		4000		8900	
Organics								
Acenaphthene	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Acenaphthylene	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Anthracene	0.0067	U	0.2		0.0067	U	0.0067	U
Benzo(a)anthracene	0.0067	U	0.073		0.013		0.0067	U
Benzo(a)pyrene	0.0067	U	0.014		0.021		0.0067	U
Benzo(b)fluoranthene	0.0067	U	0.065		0.048		0.021	
Benzo(g,h,i)perylene	0.0067	U	0.011		0.022		0.0067	U
Benzo(k)fluoranthene	0.0067	U	0.021		0.0067	U	0.0067	U
Chrysene	0.0067	U	0.11		0.033		0.018	
Dibenzo(a,h)anthracene	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Fluoranthene	0.0067	U	0.3		0.019		0.023	
Fluorene	0.0067	U	0.015		0.0067	U	0.0067	U
Indeno(1,2,3-cd)pyrene	0.0067	U	0.011		0.017		0.0067	U
Naphthalene	0.0067	U	0.0067	U	0.0067	U	0.0067	U
Phenanthrene	0.0067	U	0.074		0.0067	U	0.017	
Pyrene	0.0067	U	0.2		0.019		0.023	
PCBs								
Aroclor 1016	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1221	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1232	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1242	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1248	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1254	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1260	0.05	U	0.05	U	0.05	U	0.05	U

Units = mg/Kg
U = non detects
Blank space = not analyzed

Table 4-1
Columbia River Sediment Analytical Results

Sample Id	RM-SD1		RM-SD2		RM-SD3		RM-SD4	
TPH								
TPH	20	U	20	U	20	U	20	U
Gasoline	2	U	2	U	2	U	2	U
Diesel/related	25	U	25	U	25	U	25	U
Metals								
Aluminum	5000		6400		6600		6800	
Antimony	2.5	U	1.3	U	1.3	U	1.3	U
Arsenic	4		3.3		2.1		2.5	
Barium	68		97		66		66	
Beryllium	1	U	0.5	U	0.5	U	0.5	U
Cadmium	1	U	0.5	U	0.5	U	0.5	U
Calcium	2400		3600		3100		3200	
Chromium	10		12		9.6		9.5	
Cobalt	11		12		11		11	
Copper	4.9		8.9		11		12	
Iron	16000		18000		14000		14000	
Lead	10	U	8.6		5	U	5	U
Magnesium	2700		3500		2400		2500	
Manganese	270		270		150		170	
Mercury	0.2	U	0.2	U	0.2	U	0.2	U
Nickel	18		15		14		14	
Potassium	440		770		500		480	
Selenium	1	U	0.5	U	0.5	U	0.5	U
Silver	1	U	0.5	U	0.5	U	0.5	U
Sodium	220		200		290		270	
Thallium	1	U	0.5	U	0.5	U	0.5	U
Vanadium	46		45		34		34	
Zinc	59		77		57		59	

Units = mg/Kg
U = non detects
Blank space = not analyzed

Table 4-2
Columbia River Surface Water Analytical Results

Sample Id	RM-SW1		RM-SW3	
Inorganics (mg/L)				
Cyanide, Total	0.01	U	0.01	U
Fluoride	0.5	U	0.5	U
Hardness	57		61	
Organics (ug/L)				
Acenaphthene	5	U	5	U
Acenaphthylene	5	U	5	U
Anthracene	5	U	5	U
Benzo(a)anthracene	0.1	U	0.1	U
Benzo(a)pyrene	0.1	U	0.1	U
Benzo(b)fluoranthene	0.1	U	0.1	U
Benzo(g,h,i)perylene	0.1	U	0.1	U
Benzo(k)fluoranthene	0.1	U	0.1	U
Chrysene	0.1	U	0.1	U
Dibenzo(a,h)anthracene	0.1	U	0.1	U
Fluoranthene	0.1	U	0.1	U
Fluorene	5	U	5	U
Indeno(1,2,3-cd)pyrene	0.1	U	0.1	U
Naphthalene	5	U	5	U
Phenanthrene	5	U	5	U
Pyrene	0.5	U	0.5	U
PCBs (ug/L)				
Aroclor 1016	1	U	1	U
Aroclor 1221	2	U	2	U
Aroclor 1232	1	U	1	U
Aroclor 1242	1	U	1	U
Aroclor 1248	1	U	1	U
Aroclor 1254	1	U	1	U
Aroclor 1260	1	U	1	U
U = non detects				
Blank spaces = not analyzed				

Table 4-2
Columbia River Surface Water Analytical Results

Sample Id	RM-SW1		RM-SW3	
TPH (mg/L)				
Gasoline	0.2	U	0.2	U
Diesel/related (C12-C24)	0.5	U	0.5	U
Heavy oil/related (C24-C40)	1	U	1	U
Metals (ug/L)				
Aluminum	0.1	U	0.74	
Antimony	0.005	U	0.005	U
Arsenic	0.004	U	0.004	U
Barium	0.02	U	0.02	U
Beryllium	0.02	U	0.02	U
Cadmium	0.00025	U	0.00025	U
Calcium	15		17	
Chromium	0.02	U	0.02	U
Cobalt	0.05	U	0.05	U
Copper	0.02	U	0.02	U
Iron	0.1	U	0.48	
Lead	0.004	U	0.004	U
Magnesium	4.7		4.6	
Manganese	0.02	U	0.02	U
Mercury	0.0005	U	0.0005	U
Nickel	0.05	U	0.05	U
Potassium	1		1	U
Selenium	0.004	U	0.004	U
Silver	0.02	U	0.02	U
Sodium	6.2		5.5	
Thallium	0.004	U	0.004	U
Vanadium	0.02	U	0.02	U
Zinc	0.05	U	0.05	U

U = non detects
Blank spaces = not analyzed

Table 4-3
Company Lake Sediment Analytical Results

Sample Id	RM-SD5		RM-SD5D		RM-SD6		RM-SD7		RM-SD8		RM-SD9		RM-SD10	
TPH														
TPH	660		520		1500		710		620		1300		1200	
Gasoline	2	U	2	U	2	U	2	U	2	U	2	U	2	U
Diesel/related	550		480		1300		1300		600		1700		900	
Metals														
Aluminum	25000		23000		26000		33000		63000		44000		48000	
Antimony	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Arsenic	6.2		5		18		24		50		20		22	
Barium	140		130		410		410		420		380		420	
Beryllium	0.2	U	0.2	U	2.7		4.3		3.4		0.2	U	2.8	
Cadmium	2.3		2.2		16		17		4		37		10	
Calcium	22000		20000		110000		130000		58000		84000		120000	
Chromium	19		18		32		40		78		28		23	
Cobalt	13		12		10		15		38		16		17	
Copper	75		72		170		190		360		220		170	
Iron	24000		22000		36000		45000		59000		40000		33000	
Lead	30		31		170		190		74		300		79	
Magnesium	4700		4400		2100		2400		3400		2300		2000	
Manganese	410		150		1600		2000		3100		1300		4600	
Mercury	0.28		0.26		1.7		1.8		2.2		0.57		1.4	
Nickel	30		30		140		180		600		150		150	
Potassium	1500		1500		1200		1500		2600		1600		1500	
Selenium	0.91		0.91		6.4		6.9		3.4		5.8		5.8	
Silver	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Sodium	2000		1900		3700		3800		4600		3500		4400	
Thallium	0.72		0.2	U	4.1		4.5		0.2	U	7		2	
Vanadium	50		56		83		120		280		75		72	
Zinc	160		160		420		410		240		680		520	

Units = mg/Kg
U = non detects
Blank space = not analyzed

Table 4-4
Company Lake Surface Water Analytical Results

Sample Id	RM-SW5		RM-SW6		RM-SW10	
Inorganics (mg/L)						
Cyanide, Total	0.01	U	0.01	U	0.01	U
Fluoride	2.3		3		1.7	
Hardness	73		82		84	
Organics (ug/L)						
Acenaphthene	1	U	1	U	1	U
Acenaphthylene	3	U	3	U	3	U
Anthracene	0.2	U	0.2	U	0.2	U
Benzo(a)anthracene	0.1	U	0.1	U	0.1	U
Benzo(a)pyrene	0.1	U	0.1	U	0.1	U
Benzo(b)fluoranthene	0.1	U	0.1	U	0.1	U
Benzo(g,h,i)perylene	0.1	U	0.1	U	0.1	U
Benzo(k)fluoranthene	0.1	U	0.1	U	0.1	U
Chrysene	0.1	U	0.1	U	0.1	U
Dibenzo(a,h)anthracene	0.2	U	0.2	U	0.2	U
Fluoranthene	0.5	U	0.5	U	0.5	U
Fluorene	0.5	U	0.5	U	0.5	U
Indeno(1,2,3-cd)pyrene	0.2	U	0.2	U	0.2	U
Naphthalene	1	U	1	U	1	U
Phenanthrene	0.2	U	0.2	U	0.2	U
Pyrene	0.2	U	0.2	U	0.2	U
PCBs (ug/L)						
Aroclor 1016	1	U	1.1	U	1.1	U
Aroclor 1221	2	U	2.2	U	2.2	U
Aroclor 1232	1	U	1.1	U	1.1	U
Aroclor 1242	1	U	1.1	U	1.1	U
Aroclor 1248	1	U	1.1	U	1.1	U
Aroclor 1254	1	U	1.1	U	1.1	U
Aroclor 1260	1	U	1.1	U	1.1	U
U = non detects						
Blank spaces = not analyzed						

Salmon Creek

Salmon Creek is a drainage that flows onto the RMC property from the south. The drainage passes along the west side of the south wetlands area, north along the property line, and under Sundial Road, then exits on the west side of the plant site. Because it is believed that process wastewater may have been discharged to the south wetlands in the past, sampling was conducted in Salmon Creek to evaluate the presence of constituents offsite. Analytical data for samples collected in Salmon Creek are provided in Tables 4-5 and 4-6.

Summary of Previous Sampling

No previous sampling was conducted by EPA in the Salmon Creek Area.

Work Performed

Four sediment samples (RM-SD11 to RM-SD14), one sediment duplicate (RM-SD14D), and two surface water (RM-SW11 and RM-SW14) samples were collected and analyzed for cyanide, fluoride, PAHs, PCBs, metals, TOC, and TPH (gasoline, diesel, and total).

Field Observations

Visual characterization of each site during sampling revealed no unusual features. Samples appeared to be typical of sediments or surface water commonly found in undisturbed environments. Water depth was 1 to 2 feet where sediment samples were collected.

Sediment sample RM-SD11 was described as consisting of sandy material. Sample RM-SD12 was collected at a location containing leaves and twigs. RM-SD13 and RM-SD14 were described as having coarse sand with some organics. Field observations indicated that cattle have access to the stream at the locations of samples RM-SD13 and RM-SD14.

No unusual characteristics were noted for the surface water samples.

Summary of Sampling Results

Sediment sample RM-SD11, collected as Salmon Creek enters the RMC property, contained no detectable concentrations of cyanide, fluoride, or PCBs. PAHs were detected at concentrations less than 0.5 mg/kg. TPH was identified at 290 mg/kg. TPH diesel was measured at 170 mg/kg. Metal constituents were found at the concentrations indicated in Table 4-5.

Sample RM-SD12 was similar to RM-SD11 except that it had more numerous PAH detections and at higher concentrations (less than 2.5 mg/kg). Cyanide was detected at 2.2 mg/kg and metal concentrations were only slightly higher than those detected in sample RM-SD11. TPH was present in the sample at a concentration of 120 mg/kg. Gasoline and diesel TPH constituents were not detected.

Table 4-5
Salmon Creek Sediment Analytical Results

Sample Id	RM-SD11		RM-SD12		RM-SD13		RM-SD14		RM-SD14D	
Inorganics										
Cyanide, Total	0.5	U	2.2		0.1	U	0.1	U	0.1-	U
Fluoride	5	U	5	U	5	U	5	U	5	U
TOC	25000		29000		12000		1200		2000	
Organics										
Acenaphthene	0.034	U	0.067	U	0.034	U	0.0067	U	0.0067	U
Acenaphthylene	0.034	U	0.067	U	0.034	U	0.0067	U	0.0067	U
Anthracene	0.034	U	0.067	U	0.034	U	0.0067	U	0.0067	U
Benzo(a)anthracene	0.034	U	0.92		0.39		0.02		0.014	
Benzo(a)pyrene	0.034	U	1.1		0.56		0.031		0.02	
Benzo(b)fluoranthene	0.22		2.5		1		0.073		0.04	
Benzo(g,h,i)perylene	0.18		0.88		0.36		0.017		0.013	
Benzo(k)fluoranthene	0.034	U	0.56		0.22		0.014		0.0067	U
Chrysene	0.034	U	1		0.41		0.03		0.014	
Dibenzo(a,h)anthracene	0.034	U	0.067	U	0.083		0.0067	U	0.0067	U
Fluoranthene	0.034	U	1.2		0.41		0.02		0.016	
Fluorene	0.034	U	0.067	U	0.034	U	0.0067	U	0.0067	U
Indeno(1,2,3-cd)pyrene	0.16		0.72		0.32		0.02		0.011	
Naphthalene	0.034	U	0.067	U	0.034	U	0.0067	U	0.0067	U
Phenanthrene	0.034	U	0.4		0.15		0.0067	U	0.0067	U
Pyrene	0.14		1.3		0.46		0.021		0.017	
PCBs										
Aroclor 1016	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1221	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Aroclor 1232	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1242	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1248	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1254	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
Aroclor 1260	0.05	U	0.23		0.05	U	0.05	U	0.05	U

Units = mg/Kg
U = non detects
Blank space = not analyzed

Table 4-5
Salmon Creek Sediment Analytical Results

Sample Id	RM-SD11		RM-SD12		RM-SD13		RM-SD14		RM-SD14D	
TPH										
TPH	290		120		24		20	U	20	U
Gasoline	2	U	2	U	2	U	2	U	2	U
Diesel/related	170		25	U	25	U	25	U	25	U
Metals										
Aluminum	13000		17000		7800		1500		3600	
Antimony	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Arsenic	2.1		4		1.3		0.45		0.77	
Barium	72		88		36		6.3		11	
Beryllium	0.2	U	0.2	U	0.2	U	0.25	U	0.2	U
Cadmium	0.2	U	1.3		0.2	U	0.25	U	0.2	U
Calcium	5200		5200		3200		1400		2600	
Chromium	14		19		9		1.8		5.1	
Cobalt	13		18		7.8		3.4		4	
Copper	16		56		20		3.8		7.1	
Iron	24000		25000		12000		3700		9000	
Lead	16		32		10		2.5	U	2	U
Magnesium	2700		2600		1300		170		570	
Manganese	360		200		73		24		66	
Mercury	0.042	U	0.2	U	0.2	U	0.2	U	0.2	U
Nickel	12		44		11		4.1		4.7	
Potassium	600		640		320		62		100	
Selenium	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Silver	0.2	U	0.2	U	0.2	U	0.25	U	0.2	U
Sodium	600		640		410		150		410	
Thallium	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Vanadium	64		80		41		12		28	
Zinc	130		260		76		10		26	

Units = mg/Kg
U = non detects
Blank space = not analyzed

Table 4-6
Salmon Creek Surface Water Analytical Results

Sample Id	RM-SW11		RM-SW14		RM-SW14D	
Inorganics (mg/L)						
Cyanide, Total	0.01	U	0.01	U	0.01	U
Fluoride	0.5	U	0.5	U	0.5	U
Hardness	57		61		58	
Organics (ug/L)						
Acenaphthene	5	U	5	U	5	U
Acenaphthylene	5	U	5	U	5	U
Anthracene	5	U	5	U	5	U
Benzo(a)anthracene	0.1	U	0.1	U	0.1	U
Benzo(a)pyrene	0.1	U	0.1	U	0.1	U
Benzo(b)fluoranthene	0.1	U	0.1	U	0.1	U
Benzo(g,h,i)perylene	0.1	U	0.1	U	0.1	U
Benzo(k)fluoranthene	0.1	U	0.1	U	0.1	U
Chrysene	0.1	U	0.1	U	0.1	U
Dibenzo(a,h)anthracene	0.1	U	0.1	U	0.1	U
Fluoranthene	0.1	U	0.1	U	0.1	U
Fluorene	5	U	5	U	5	U
Indeno(1,2,3-cd)pyrene	0.1	U	0.1	U	0.1	U
Naphthalene	5	U	5	U	5	U
Phenanthrene	5	U	5	U	5	U
Pyrene	0.5	U	0.5	U	0.5	U
PCBs (ug/L)						
Aroclor 1016	1	U	1	U	1	U
Aroclor 1221	2	U	2	U	2	U
Aroclor 1232	1	U	1	U	1	U
Aroclor 1242	1	U	1	U	1	U
Aroclor 1248	1	U	1	U	1	U
Aroclor 1254	1	U	1	U	1	U
Aroclor 1260	1	U	1	U	1	U
U = non detects						
Blank spaces = not analyzed						

Table 4-6
Salmon Creek Surface Water Analytical Results

Sample Id	RM-SW11		RM-SW14		RM-SW14D	
TPH (mg/L)						
Gasoline	0.2	U	0.2	U	0.2	U
Diesel/related (C12-C24)	0.5	U	0.5	U	0.5	U
Heavy oil/related (C24-C40)	1	U	1	U	1	U
Metals (ug/L)						
Aluminum	0.1		0.48		0.28	
Antimony	0.005	U	0.005	U	0.005	U
Arsenic	0.004	U	0.004	U	0.004	U
Barium	0.02	U	0.02	U	0.02	U
Beryllium	0.02	U	0.02	U	0.02	U
Cadmium	0.00025	U	0.00025	U	0.00025	U
Calcium	13		15		14	
Chromium	0.02	U	0.02	U	0.02	U
Cobalt	0.05	U	0.05	U	0.05	U
Copper	0.02	U	0.02	U	0.02	U
Iron	0.17		0.4		0.27	
Lead	0.004	U	0.004	U	0.004	U
Magnesium	6		5.8		5.7	
Manganese	0.02	U	0.02	U	0.02	U
Mercury	0.0005	U	0.0005	U	0.0005	U
Nickel	0.05	U	0.05	U	0.05	U
Potassium	2.3		1.7		2.4	
Selenium	0.004	U	0.004	U	0.004	U
Silver	0.02	U	0.02	U	0.02	U
Sodium	5.8		7		6.9	
Thallium	0.004	U	0.004	U	0.004	U
Vanadium	0.02	U	0.02	U	0.02	U
Zinc	0.05	U	0.05	U	0.05	U
U = non detects						
Blank spaces = not analyzed						

Samples RM-SD13 and RM-SD14, collected after Salmon Creek exits the RMC property, showed constituents and concentrations similar to those of RM-SD12. No cyanide or fluoride were detected in either sample. Total PAHs were detected in RM-SD13 at about 4.4 mg/kg and RM-SD14 at about 0.25 mg/kg. PAHs were lower in the sample collected closer to RMC (RM-SD14) and higher in the sample collected farther offsite (RM-SD13). This may be because of the relatively lower TOC concentration detected at RM-SD13. RM-SD13 also contained 24 mg/kg of TPH (gasoline and diesel were not detected). Metal concentrations are shown in Table 4-5. RM-SD14 contained no measurable TPH.

Constituent concentrations in surface water samples RM-SW14 and RM-SW14D were similar to those detected in the Columbia River.

East Lake

East Lake is located roughly 600 feet east of Company Lake. Aerial photographs from the 1930s and 1940s indicate that Company Lake, East Lake, and the Sandy River were once connected. Drainage channels cut from the northwest corner of Company Lake to the Columbia River caused the water body to decrease in size until East Lake separated from Company Lake and, by 1966, from the Sandy River. It is possible that these surface water features developed in a depression caused by a former channel of the Sandy River. Analytical data for samples collected in East Lake are provided in Tables 4-7 and 4-8.

Summary of Previous Sampling

There are no known previous analytical data for East Lake.

Work Performed

CH2M HILL personnel collected one surface water (RM-SW18) and one sediment sample (RM-SD18) from East Lake. The samples were collected from a boat near mid-lake at a water depth of about 2 feet. Samples were tested for cyanide, fluoride, PAHs, and PCBs. In addition, TPH was measured in sediments.

Field Observations

The RM-SD18 sediments contained little vegetative matter, and consisted of a gray, fine-grained material. There was no noticeable odor or any unusual characteristic associated with East Lake sediments. Surface water in East Lake was generally turbid, with some algal growth observed. No vegetation was observed covering the water surface.

Summary of Sampling Results

No cyanide, fluoride, PCBs, or TPH was detected in the East Lake sediment sample. Total PAHs (as determined by a sum of species) were 7.4 mg/kg. In general, metals concentrations in East Lake sediments are comparable to the concentrations observed in drainage ditch

Table 4-7
East Lake Sediment Analytical Results

Sample Id	RM-SD18	
Inorganics		
Cyanide, Total	0.5	U
Fluoride	5	U
TOC	38000	
Organics		
Acenaphthene	0.17	U
Acenaphthylene	0.17	U
Anthracene	0.17	U
Benzo(a)anthracene	0.72	
Benzo(a)pyrene	0.9	
Benzo(b)fluoranthene	1.4	
Benzo(g,h,i)perylene	0.76	
Benzo(k)fluoranthene	0.17	U
Chrysene	1	
Dibenzo(a,h)anthracene	0.17	U
Fluoranthene	0.96	
Fluorene	0.17	U
Indeno(1,2,3-cd)pyrene	0.69	
Naphthalene	0.17	U
Phenanthrene	0.17	U
Pyrene	1	
PCBs		
Aroclor 1016	0.05	U
Aroclor 1221	0.1	U
Aroclor 1232	0.1	U
Aroclor 1242	0.05	U
Aroclor 1248	0.05	U
Aroclor 1254	0.05	U
Aroclor 1260	0.05	U
Units = mg/Kg		
U = non detects		
Blank space = not analyzed		

Table 4-7
East Lake Sediment Analytical Results

Sample Id	RM-SD18	
TPH		
TPH	140	
Gasoline	2	U
Diesel/related	25	U
Metals		
Aluminum	20000	
Antimony	0.5	U
Arsenic	3.2	
Barium	90	
Beryllium	0.2	U
Cadmium	1.1	
Calcium	5500	
Chromium	19	
Cobalt	14	
Copper	38	
Iron	24000	
Lead	28	
Magnesium	4500	
Manganese	220	
Mercury	0.042	U
Nickel	29	
Potassium	1000	
Selenium	0.2	U
Silver	0.2	U
Sodium	760	
Thallium	0.2	U
Vanadium	69	
Zinc	120	
Units = mg/Kg		
U = non detects		
Blank space = not analyzed		

Table 4-8
East Lake Surface Water Analytical Results

Sample Id	RM-SW18	
Inorganics (mg/L)		
Cyanide, Total	0.01	U
Fluoride	0.7	
Hardness	21	
Organics (ug/L)		
Acenaphthene	1	U
Acenaphthylene	3	U
Anthracene	0.2	U
Benzo(a)anthracene	0.1	U
Benzo(a)pyrene	0.1	U
Benzo(b)fluoranthene	0.1	U
Benzo(g,h,i)perylene	0.1	U
Benzo(k)fluoranthene	0.1	U
Chrysene	0.1	U
Dibenzo(a,h)anthracene	0.2	U
Fluoranthene	0.5	U
Fluorene	0.5	U
Indeno(1,2,3-cd)pyrene	0.2	U
Naphthalene	1	U
Phenanthrene	0.2	U
Pyrene	0.2	U
PCBs (ug/L)		
Aroclor 1016	1.1	U
Aroclor 1221	2.2	U
Aroclor 1232	1.1	U
Aroclor 1242	1.1	U
Aroclor 1248	1.1	U
Aroclor 1254	1.1	U
Aroclor 1260	1.1	U
U = non detects		
Blank spaces = not analyzed		

Table 4-8
East Lake Surface Water Analytical Results

Sample Id	RM-SW18	
TPH (mg/L)		
Gasoline	0.2	U
Diesel/related (C12-C24)	0.5	U
Heavy oil/related (C24-C40)	5.1	
Metals (ug/L)		
Aluminum	0.1	U
Antimony	0.005	U
Arsenic	0.004	U
Barium	0.02	U
Beryllium	0.02	U
Cadmium	0.00025	U
Calcium	5.2	
Chromium	0.02	U
Cobalt	0.05	U
Copper	0.02	U
Iron	0.89	
Lead	0.004	
Magnesium	1.9	
Manganese	0.085	
Mercury	0.0005	U
Nickel	0.05	U
Potassium	1.8	
Selenium	0.004	U
Silver	0.02	U
Sodium	3.7	
Thallium	0.004	U
Vanadium	0.02	U
Zinc	0.05	U
U = non detects		
Blank spaces = not analyzed		

sediments upgradient of the site, and below concentrations observed in Columbia River sediment upstream of the facility.

No cyanide, PAHs, or PCBs were detected in the East Lake surface water sample. Fluoride was detected at 0.7 mg/L. In general, metals concentrations in East Lake surface water were lower than at the other locations where surface water was sampled.

Summary

Surface water and sediment samples were collected from four general locations near the RMC facility:

- Columbia River
- Company Lake and outfall ditch
- Salmon Creek
- East Lake

Analytical Results

Analytical results are summarized for each area as follows.

Columbia River

No cyanide, fluoride, PCBs, or TPHs were detected in two Columbia River sediment samples collected upstream of the RMC facility. PAHs (as a sum of detected constituents) were found in one of the samples at 1.1 mg/kg total.

No cyanide, TPH, or PCBs were detected in two Columbia River sediment samples collected near the Company Lake outfall. Fluoride was detected in one sample at 13 mg/kg. Detected PAH concentrations (0.19 and 0.10 mg/kg as a sum of detected constituents) are lower than the concentration noted in sediment upstream of the RMC facility. Metals concentrations in sediment at this location are similar to concentrations detected upstream of the RMC facility.

No cyanide, fluoride, PAHs, or PCBs were detected in Columbia River surface water upstream of the RMC facility or near the Company Lake outfall.

Company Lake and Outfall Ditch

In the five sediment samples collected from the bottom of Company Lake, total cyanide was detected in only one sample (10 mg/kg), fluoride ranged from 780 to 5800 mg/kg, total PAHs (as a sum of detected constituents) ranged from about 400 to 24,000 mg/kg, PCBs ranged from 2 to 3.5 mg/kg, and TPH ranged from 620 to 1,300 mg/kg. Metal concentrations were generally elevated relative to the sediments in the Columbia River.

No cyanide, PAHs, or PCBs were detected in Company Lake surface water. Detected fluoride concentrations ranged from 1.7 to 3 mg/L.

Salmon Creek

Four sediment samples were collected from the Salmon Creek drainage system; one where the drainage enters the southwestern portion of the RMC site, one just prior to the drainage exiting the site at the eastern edge of Sundial Road, and two just west of Sundial Road. Where the drainage enters the site, no cyanide, fluoride, or PCBs were detected. PAHs were detected at a concentration similar to the upstream Columbia River sediment, and TPH was detected at 290 mg/kg.

No cyanide, fluoride, or PCBs were detected in the two sediment samples collected west of Sundial Road. Total PAHs (as a sum of detected constituents) were measured at 4.4 and 0.25 mg/L, and TPH was detected in one sample at 24 mg/L.

In general, metals concentrations in Salmon Creek sediments are slightly elevated relative to Columbia River sediments, though lower than Company Lake sediments.

Surface water samples collected where the Salmon Creek drainage enters the site and where it exits the site near Sundial Road showed no detectable concentrations of cyanide, fluoride, PAHs or PCBs. Metal concentrations in Salmon Creek surface water are similar to concentrations observed in Columbia River water both upstream and downstream of the RMC facility.

East Lake

One sediment sample and one surface water sample was collected from East Lake, a small pond east of Company Lake. No cyanide, fluoride, PCBs, or TPH were detected in the East Lake sediment sample. Total PAHs (as a sum of detected constituents) were measured at 7.4 mg/kg. In general, metals concentrations in East Lake sediments are comparable to the concentrations observed in drainage ditch sediments upgradient of the site and lower than observed in Columbia River sediments.

No cyanide, PAHs, or PCBs were detected in the East Lake surface water sample. Fluoride was detected at 0.7 mg/L. In general, metals concentrations in East Lake surface water were lower than at the other locations where surface water was sampled.

Table 4-4
Company Lake Surface Water Analytical Results

Sample Id	RM-SW5		RM-SW6		RM-SW10	
TPH (mg/L)						
Gasoline	0.2	U	0.2	U	0.2	U
Diesel/related (C12-C24)	0.5	U	0.5	U	0.5	U
Heavy oil/related (C24-C40)	1	U	1	U	1	U
Metals (ug/L)						
Aluminum	0.6		0.1	U	0.1	U
Antimony	0.005	U	0.005	U	0.005	U
Arsenic	0.004	U	0.004	U	0.004	U
Barium	0.02	U	0.02	U	0.02	U
Beryllium	0.02	U	0.02	U	0.02	U
Cadmium	0.00025	U	0.00025	U	0.00025	U
Calcium	19		23		23	
Chromium	0.02	U	0.02	U	0.02	U
Cobalt	0.05	U	0.05	U	0.05	U
Copper	0.02	U	0.02	U	0.02	U
Iron	0.34		0.1	U	0.3	
Lead	0.004	U	0.004	U	0.004	U
Magnesium	6.3		6		6.3	
Manganese	0.02	U	0.059		0.02	U
Mercury	0.0005	U	0.0005	U	0.0005	U
Nickel	0.05	U	0.05	U	0.05	U
Potassium	3.1		3.5		3.6	
Selenium	0.004	U	0.004	U	0.004	U
Silver	0.02	U	0.02	U	0.02	U
Sodium	21		27		19	
Thallium	0.004	U	0.004	U	0.004	U
Vanadium	0.02	U	0.02	U	0.02	U
Zinc	0.05	U	0.05	U	0.05	U
U = non detects						
Blank spaces = not analyzed						

Field Observations

The RM-SD5 sediments contained leaves and other vegetative matter. Leaves and twigs were removed before the sample was placed in the jar. The presence of organic matter is indicated by a TOC concentration of 28,000 mg/kg.

Aquatic vegetation covered the western portion of the lake. Near the inflow to the lake (at RM-SD10) the sediments were covered with algal mats. Duck weed and floating algae were noticed in the surface water. The eastern portion of Company Lake (where RM-SD6 to RM-SD8 were collected) is deeper and had no rooted aquatic vegetation.

Samples RM-SD6 to RM-SD10 were characterized in the field as fine-grained sediments with a black or gray-black color. Samples had a strong petroleum smell, and had a noticeable sheen in the mixing bowl. The high organic content of the sediments was indicated by TOC concentrations between 87,000 and 240,000 mg/kg.

Surface water in Company Lake had generally low turbidity at the time of sampling. Sample RM-SW10, collected near the point where water enters Company Lake, had a slight sheen.

Summary of Sampling Results

Company Lake outfall sediment samples (RM-SD5 and RM-SD5 duplicate) contained no measurable cyanide. Fluoride concentrations were 1,200 mg/kg and 700 mg/kg, respectively. Total PAH concentrations (as a sum of species) exceeded 1,000 mg/kg with some individual PAHs (e.g., benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene) ranging in concentrations from 110 to 260 mg/kg. TPH diesel was also detected in this location at a concentration of about 500 mg/kg. Metal concentrations in the outfall sediments were slightly higher than in the Columbia River sediment samples.

Company Lake sediment samples contained cyanide in one sample (10 mg/kg), fluoride concentrations between 780 and 5,800 mg/kg, PAHs, and metals. Most notable in Company Lake sediments was the presence of PAHs. Total PAHs exceeded 15,000 mg/kg in two samples: RM-SD6 (greater than 18,000 mg/kg) and RM-SD9 (greater than 24,000 mg/kg). Individual PAH concentrations exceeding 1,000 mg/kg were noted in these same locations for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene. Company Lake sediments in other locations contained total PAH concentrations between 350 and 6,000 mg/kg.

Surface water samples collected in Company Lake and the outfall ditch showed similar constituent concentrations. PAHs and cyanide were not detected. Fluoride was measured at concentrations less than 2 mg/L. Metal concentrations are shown in Table 4-4.